Summary

Management by client and contractor (Chapter 1)

General (§ 79–87)

1 Before work starts the client has to make policy decisions on the form of contract, the number of direct contractors, his involvement in plant design, the way he will control variations in design and on penalties and incentives.

2 These policies are interdependent, and the intention in one can frustrate the intention in another. The client must therefore seek to devise a strategy of compatible policies. We cannot recommend a single inflexible formula covering all aspects suitable for all clients for all projects for all circumstances, but we do think that for each particular objective and situation there is an optimum arrangement of compatible policies and that clients should be sufficiently flexible to adopt the different combinations of policies that are required. We consider that contradictions and inconsistencies between these policies have been one of the reasons for the slow tempo of work and the rising costs of work on many sites. We therefore urge clients to make a searching reappraisal of their present thinking.

Form of contract (§ 88–103)

3 While in certain conditions lump sum contracts are the most effective form of contract these conditions may not apply in plant erection work on large industrial construction sites. We recommend, therefore, that all clients examine more carefully the use of the considerable range of reimbursable contracts open to them. We also believe that negotiated contracts have their place. We think it most important that those concerned with the review of the expenditure of public money should bear in mind that the ultimate cost and time of completion of a project is more important than the amount of original tenders.

Number of contractors directly accountable to the clients (§ 104–112)

4 We have considered the arguments for and against a client severely limiting the number of direct contractors immediately accountable to him, and we have concluded that on balance the client will exercise better control through an organisational pyramid, the steps of which are a limited number of direct contractors to subcontractors and possibly to sub-subcontractors rather than if he himself attempts to control directly very many different contractors. This system, however, demands of the main contractor more organising ability than some now possess.

5 There is also a case for the use on large sites of the specialist 'engineer-constructor', ie a single managing contractor. In addition to their special erection skills and wide experience, such contractors usually employ directly all or most of the site labour—a feature offering major advantages.

6 We think the consolidation into larger units of many of the specialist subcontractors and manufacturers would be beneficial. We consider that the major clients could hasten this process by their procurement policies.

The involvement of the client in plant research and design (§ 113–118)

7 Clients have a duty to ensure that plant will provide the specified service throughout its planned life. In view of this, and bearing in mind the size of a client's organisation and the continuity of his construction programme, he will decide upon the extent of his involvement in the research, development and detailed design of the plant he uses. But when the client chooses to take the technical initiative he becomes more responsible for the result—and this should

be explicitly understood by client and contractor. In seeking involvement in any aspect of design, the client, too, should recognise the pitfalls associated with this policy, the chief of which is a propensity to search for perfection and a reluctance to freeze specifications. It should also be born in mind that notwithstanding the client's participation in design, the plant manufacturer or contractor must still maintain a research and design capacity. The formulation of plant designs will not fall into two tidy divisions between the client's and the contractor's design staffs. There will be overlapping of the total design resources used by client and contractor together, which will increase the likelihood of disputes about who does what, and hence lead to a greater risk of delays in design programmes.

(§ 119)

8 We have also given attention to the basic engineering standards maintained by clients. These can become both too voluminous and too detailed. We recommend, therefore, that clients from time to time look at these basic standards and cut out the irrelevant and unnecessary detail.

Design delays and variations
(§ 120–127)

9 There is strong opinion that late design information or changes in design is the most serious single cause of delays in projects. That being so, we suggest clients reappraise the value of allowing the design and construction phases of a project to overlap (though procurement of long-delivery items may often precede completion of plant design).

10 We maintain that some variations are not justified and are not the result of a businesslike evaluation. Although many variations are introduced by contractors the control of variations lies mainly in the hands of the clients. In some cases there seems to be a real discrepancy between what a client organisation believes to be and advertises as its control system over variations and what actually happens. We recommend that clients make a searching re-examination of their policies here, and ensure that there is an effective and specific discipline for the approval of variations of different magnitudes at different levels of the clients' organisations. We also recommend that boards of directors and those examining the expenditure of public bodies should consider calling for the evaluation exercises which should have preceded all variations.

Penalties and incentives
(§ 128–136)

11 There seems little point in a client proposing either a penalty or an incentive unless he is prepared to establish the environment within which they can be an effective spur to a contractor. This means the client must be prepared to exercise rigorous control over variations, and clarify his part in the design process, and also if he is managing the site to integrate effectively the work of different contractors. To persist with incentives or penalties where these conditions are not met has little value, and gives a false impression of discipline.

12 When these conditions are met, however, we have concluded that the offer of extra payment to the contractor for special performance, where this is needed, has an advantage over requiring payment from them for poor performance, and is more likely to stimulate efficiency: the effectiveness of either, however, is not great.

Site services
(§ 137–140)

13 Lack of definition in contract documents of the site services to be provided causes misunderstandings. The onus for such definition lies upon the party inviting tenders. We recommend that invitations to tender include a scope of work section specifying the services available, such as access roads, storage areas and power. The use of imprecise expressions such as 'all reasonable provision' should be avoided. We commend the present practice of those clients who insist, where possible, that tenderers visit the site before contracts are signed to gain a clear impression of working conditions.

14 We also recommend that clients or managing contractors should arrange the allocation of cranes and in addition provide lifts for as many men working above ground as possible.

Clients' project teams
(§ 141–152)

15 The scale and frequency of projects shape the client's approach to project management but we consider that our discussions enable us to put forward certain guides. First, the client's project management should have sufficient authority, and be seen to have it by contractors, to take quick decisions affecting construction. Low financial ceilings and imprecise definitions of accountability are likely to inhibit speed and responsibility in decision-making and undermine authority.

16 Secondly, we are impressed by the system in which some clients' project management is associated with the project from the letting of contracts to commissioning. We feel this system brings construction know-how into design, and involves those associated with design in the monitoring of construction. We should like to see this system more widely used.

17 Thirdly, we consider that the rewards of clients' project management do not on occasion match up to their responsibilities. The installed cost of a single large project can exceed £100 million and salaries of those responsible for getting them built should, in our view, reflect the importance of the work.

Training (Chapter 2)

Management training
(§ 153–159)

18 Tailor-made courses for managers in mechanical and electrical construction are needed, and are more likely to be successful if the industry establishes permanent links with certain colleges and if the programmes are overseen by a single training board (in place of the present two).

19 A coherent training programme will help give mechnical and electrical construction recognition as a skilled profession. But enhanced professional status must be matched in construction management by better remuneration and better-defined responsibilities and authority.

Craft training
(§ 160–182)

20 The mechanical and electrical craftsmen presently employed on large sites are principally men who received their apprentice training outside the industry; when they enter construction they are unfamiliar with many tasks on site.

21 Although comprehensive on-site training including apprenticeship might be the ideal, practical difficulties associated with the large-sites environment imply that the industry will continue to draw on other sectors for recruits qualified to normal craft standards, at least for some years to come. The scope for innovation will lie in turning newly-recruited tradesmen into competent construction craftsmen.

22 The CITB is already planning 'conversion' courses for qualified men and improvers, and with the support of the industry the programme should show good results. The onus, however, must be on firms to provide facilities on site. We look for the maximum of co-operation between the CITB and EITB in providing advice and assistance.

23 There is a gratifying measure of agreement among unions and employers regarding the key role of systematic training programmes, but certain issues will have to be decided soon, ie whether differentials should be paid in respect of proficiency gradings, and whether the gradings are to be awarded by formal examinations or course assessments. These problems could have an adverse effect on the training if they are not resolved quickly.

24 In addition to technical training, education is required to improve industrial relations. Instruction on the working of site and other agreements is clearly desirable, and courses of the sort available to stewards and managers in other industries should be adapted to the needs of constructors.

Programming (Chapter 3)

(§ 183–185) 25 We welcome the increasing tendency to specify in contracts 'key events'—relating to stages of design and manufacture an well as intermediate and final construction—to which contractors and clients are committed. We recommend that in support of such commitment contractors should furnish programmes as evidence that they appreciate the implications of their undertakings.

(§ 186–189) 26 After formulation of the initial plan we find there is frequent unjustified reluctance, greatest at the design stage, to maintain detailed programmes for monitoring performance and devising remedial action to avert delays.

(§ 195–203) 27 There should be an extension of courses in planning techniques in institutions where research into improved methods could also be undertaken.

(§ 196–198) 28 Many contractors cannot attain integrated planning and control because the responsibility for design, manufacture and construction is fragmented.

(§ 199–202) 29 We recommend the careful investigation during the planning stage of the potential economies of shiftworking.

(§ 204–207) 30 While networks are appropriate to get the 'logic' of a programme right, they are frequently inappropriate for communicating information where simpler methods have their place.

(§ 208) 31 We consider it worthwhile to spend up to ½ per cent of the total installed cost of a project on planning resources.

Industrial relations problems (Chapter 4)

Pay and conditions

(§ 209–218) 32 Investment in the electricity supply, oil refining, and process industries has increased rapidly since the war, and there has been a spectacular increase in plant size. Investment is concentrated in 50 or so projects many of which cluster together.

33 The need for speedy completion has often persuaded management on each site to concede pay increases without regard for their effect on other sites and unmatched by increases in productivity.

34 As a result of haphazard local bargaining, earnings vary without equity or logic within and between sites. The several existing national agreements still govern certain conditions of employment and fringe benefits, though they do so without consistency. Attempts to introduce order on some sites have been eroded by the lack of control on others.

35 The casual nature of the work brings about constant pressure for the highest earnings, low morale and dissolution of work teams as each job nears completion.

36 One result is a strike record exceeded in Britain only in the docks and the motor industry, and very high labour turnover. More damaging still is a widespread apathy among siteworkers which is both generated by and in turn intensifies a waste of human resources to the extent that considerably less than half of working hours are effectively utilised.

A comprehensive national agreement

(§ 219–227 & 234–247) 37 We see a new national agreement, predetermined parts of which would be negotiated at site level, as the primary instrument of reform. The national agreement would give recognition to an industry identity which is highly desirable. More precisely, it would set a rate closely related to earnings, unlike those in the present agreements and reduce the pressures for incessant local bargaining. (Insofar as it exercised a determining influence on earnings it would also permit more accurate estimates of erection cost). It would provide consistency in lodging and travel allowances and secure adequate provision on these and other conditions and benefits. It would regularise the facilities afforded to trade unions on sites and establish new disputes procedures.

38 The site agreements so far concluded have been an important step in achieving more stable conditions on the oil and chemical sites on which they operate. While site negotiation cannot replace national negotiation, we acknowledge that within the framework of a national agreement negotiation at

site level on certain matters is essential. It would be concerned, for example, with arrangements for securing more flexible and hence more productive working practices, with the control of overtime, and with certain union matters (facilities for elections or for collection of dues etc). It is desirable that these matters are settled explicitly before work starts. Clients wishing to retain incentive bonus schemes would require work targets and 'gearing' to be settled on a site basis and the details of the schemes negotiated accordingly. The client would require the observance of all the terms of the national agreement by all contractors on the mechanical and electrical construction work as a condition of contract.

Incentive schemes
(§ 228–233)

39 The large majority of the working party, recognise that present incentive schemes are a continuing source of industrial disputes and wage inflation, and are ineffective in securing greater effort, and sometimes operate in the absence of work measurement; they call for a critical reappraisal of existing systems, thus leading to the abandonment of those which do not meet the stringent requirements of sound schemes.

40 We accept that some contractors supported by some clients could not at present consider abolition of bonus schemes; in these circumstances, we emphasise the need for control, calling for:

(a) guidelines laid down in the national agreement on methods of 'gearing', on targets and on the system of work measurement;

(b) the detailed formulation of bonus schemes in site-level negotiations, preferably before work starts; and

(c) strict monitoring of incentive payments by clients.

41 The unsuitability of incentive schemes in much of the industry does not remove the need for work study. We recommend the greater use of work study to improve working methods and to assist in establishing planning and control.

Institutional needs
(§ 248–251)

42 A national agreement could not be achieved unless it were preceded by a coming together of the various employers' associations for the purpose of negotiations; equally the union side would need to develop some arrangement for unifying their policies. We see the outcome of this to be the formation of a joint body which in due course would become a negotiating council for the industry.

(§ 252–259)

43 Clients should lend their support to agreements concluded in the industry and be prepared to monitor the industrial relations policies of their contractors to ensure compliance. To succeed in this they will need specialist personnel resources not possessed by all clients at present. At the national level we recommend the establishment of a clients' council to assist in this role, but also to curb the 'rogue' client or contractor, and, possibly, to provide for the exchange of information on future projects and some co-ordination of their timing.

Four matters for negotiators
(§ 260–263)

44 We recommend that there should be uniformity in the rules for payment of *travelling and lodging allowances*, in contrast to present agreements whose disparities have no logical justification and cause resentment. These allowances should be sufficiently generous: arrangements which permit men to travel daily to their homes would remove the chief social disadvantage of site work, while adequate weekend travel for those lodging away from home would help attract and retain a sufficiently large force of permanent, 'travelling' employees.

(§ 264–267)

45 The *demarcation* problem is not principally one of disputes but of acceptance by the industry of wasteful practices. We recommend extension of site negotiation on the removal of demarcation practices. We look forward in

due course to union mergers that will tend to diminish job protection. We acknowledge also the beneficial effect of greater security of employment. For the immediate future we recommend the formulation of explicit procedures for resolving such conflicts as occur.

(§ 268–271) 46 We believe that an ungrudging acceptance by management of the *role of shop stewards* will do more to promote good industrial relations than the formulation of rules defining stewards' powers. Nevertheless, national and site negotiation should decide such questions as the number of stewards, their facilities, methods of election and their right to form site-wide committees. We recommend the extension of formal training for shop stewards by the unions, but with employers offering paid day release.

(§ 272–276) 47 Grievances will tend to diminish when there is an accepted system of pay, conditions and working rules in the industry, but we recommend the reform of *grievance procedure*, involving,

(a) the formulation of a common code of discipline particularly on dismissals;

(b) on contracts where incentive schemes operate, the appointment of work study experts by both unions and employers capable of judging jointly the fairness of work 'targets' in incentive schemes—the commonest source of dispute;

(c) the rapid operation of successive stages in grievance procedures.

Amenities
(§ 277–281) 48 Amenities on some sites have been unsatisfactory and have contributed to labour unrest. We believe it to be better and more economic to remove discomforts than to pay workers for enduring them. We have therefore drawn up a 'welfare code', which sets out standards of amenities, whose adoption by clients, with the backing of contractors and unions, we urge.

Casual labour
(§ 282–307) 49 The provision of more stable employment would be the most important single step the industry could take to improve employer/employee relations and productivity. Hire and fire policies foment hostility, prevent the formation of efficient work teams, render training uneconomic, make safety education more difficult, and block the introduction of the enlightened personnel policies that will be pursued more and more in industry generally and that we wish to see adopted in construction.

50 Bearing in mind the prospects of the industry over the next decade, we suggest that it is feasible for:

(a) contractors to increase the size of their permanent workforce, and

(b) a register of siteworkers to be established, so that by the mid 1970s the industry could offer permanent employment to about three-quarters of its craftsmen (ie to 20,000 to 25,000 men), thus looking to casual men to provide only a quarter of the workforce.

Proposals for follow-up (Chapter 5)
(§ 311–316) 51 To ensure that action follows this report a steering committee of representatives of the various interests in the industry should be established. This committee would determine where action should be taken and monitor progress. It would also give rise to the national joint council for the industry we have proposed.

Introduction

The Working Party

52 The Working Party on Large Industrial Construction Sites was formed under the auspices of the National Economic Development Council and met first on 9 July 1968. Its terms of reference were,

> 'To inquire into the problems of organisation of large industrial construction sites with particular reference to labour relations, to investigate their causes and their effects on the cost of commissioning and operating plants, and to make recommendations.'

53 Membership, which was extended during the early months, consisted of senior representatives of the larger client or owner organisations, of a wide range of contractors and their associations, the general secretaries or members of the executives of the unions concerned in site work, and representatives of interested government departments and of the National Economic Development Office.

54 We regret that representatives of the Federation of Civil Engineering Contractors and the National Federation of Building Trade Employers felt unable to accept invitations to participate; while their industrial relations are conducted in a different environment from that in plant construction (with which the Working Party was chiefly concerned), the project management experience of civil engineering and building contractors would doubtless have been of interest to the Working Party while their member firms have an interest in the contractual and managerial policies we have considered.

55 Despite the special emphasis given to labour relations in the terms of reference, we acknowledged from the outset that it was equally necessary for us to study management problems; 'the problems of management by client and contractor', and 'labour problems' were accordingly made the responsibility of two sub-groups chaired, respectively, by Mr Paton and Lord Wright. It was also realised that there was an almost total lack of statistical information about the construction activity with which we were concerned and that this must be assembled from scratch, this job was assigned to a third sub-group (chaired by Mr Beales of NEDO) some of whose members with special expertise were drawn from outside the Working Party.

56 The first two groups were large, like the Working Party itself, with overlapping membership. But it was felt that discussion would be enhanced by the presence of as wide a range of experience and of interests as possible and their conclusions similarly invested with more authority. Their size meant slower progress than could be achieved by a smaller and more easily managed group and also a greater risk of failure to agree. However, to speed their work, the NEDO staff were asked to present extensive papers for debate based on prior interviews with knowledgeable people in the industry—a method which enabled anonymity to be preserved when this was desirable. In the event most of our recommendations are unanimous; and we feel, therefore, that they merit the most careful consideration.

57 The stimuli which led to the formation of the Working Party were strong and emanated from several sources. Delays in bringing new generating sets into commission were first discussed by the Electrical Engineering EDC in April 1966. In the same year the Ministry of Power was expressing concern

about delays in the construction of gas plant as well as power stations: in 1968 it appointed a Committee of Enquiry into 'Delays in commissioning CEGB power stations'.* For some time previously the Ministry of Labour had been paying close attention to the poor industrial relations record which characterised large construction sites. Finally, the Economic Development Committee for Chemicals concluded that the problems of construction delays were 'so grave' as to merit special study by a body constituted for the purpose. These were the 'institutional' expressions of concern. But the problem had undoubtedly worried individual contractors, trade unions and clients since the early '60s. Here we may note that criticism of progress in construction was made in similar terms whether the projects were power stations or plant for the gas, steel, chemical or oil industries.

Large industrial construction sites—definition

58 The problem of definition is one which could have exercised us to the exclusion of all others. Established as the Working Party on Large Industrial Construction Sites, we avoided trying to find a single, tidy, all-purpose meaning. Instead we used the term as a portmanteau whose shape was modified as the investigations required. The three main ways in which we have viewed our subject matter are 'mechanical and electrical construction', 'construction in the process industries' and 'large sites'.

59 *Mechanical and electrical construction*: this is the entity we have in mind when we report on labour matters. It is a definition which the Working Party from the outset recognised as valid and important, and the need to establish an industry identity for mechanical and electrical construction has been given much weight. The recommendations in Chapter 4 on a national agreement are intended, therefore, to apply to the whole of the mechanical and electrical construction industry and not just to the two-thirds (in terms of labour employed) engaged at any one time on 'large' sites.

60 The trades involved in this industry are erectors/riggers, pipefitters/plumbers, electricians, welders, fitters/millwrights, platers/boilermakers, and smaller numbers of other skills. There are about 50,000 men of whom about 70 per cent are craftsmen, 20 per cent semi-skilled and 10 per cent unskilled.

61 All but the erectors/riggers have counterparts in the workshop or factory and there is also some movement of men between sites and factory, shipyards and, in the case of electricians, domestic work. Siteworkers, however, require different terms of employment because the conditions under which they operate have little in common with those of the factory worker. Most site erection jobs are temporary, require the worker to live away from home or travel considerable distances daily, are arduous, often involve great discomfort, caused by working in the open or in confined spaces. (Those who may be surprised by some siteworkers' earnings on which we report should reflect that the recipients may be rising at 5.30 am, travelling two hours to a day's work—of irregular length—which entails the fixing of steel structures, perhaps at a height of 200 feet or so, and perhaps at freezing temperatures.)

62 The employers too are an identifiable group. Most of the management in mechanical and electrical construction is based on site and moves around from project to project, confronted with the problem of establishing and running what is in effect a temporary enterprise.

63 In institutional terms an industry identity is at present largely an aspiration. Some 'site' agreements are however in operation which cover all mechanical and electrical trades on a site and pay the same basic rates. The Engineering Employers' Federation have concluded with different unions or groups of unions national agreements for siteworkers with similar or, in some cases,

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*see Committee of enquiry into delays in commissioning CEGB power stations, Cmnd. 3960.

identical terms, although these differ in important respects from the site agreements. Site labour is divided in its membership between the Constructional Engineering Union (CEU), the 'Boilermakers', the EETU with which the Plumbing Trades Union has recently amalgamated, the AEF, and the Union of Sheet Metal Workers, Coppersmiths and Heating and Domestic Engineers (H & D). Employers' membership is divided between the Engineering Employers' Federation (largely firms with manufacturing interests in addition to their site work), the newly formed Oil and Chemical Plant Constructors' Association, the Electrical Contractors' Association, the Heating and Ventilating Contractors' Association, and the Thermal Insulation Contractors' Association.

64 At the formation of the Working Party, no machinery existed through which either the unions or the employers' bodies could each discuss and unify their policies. Neither is there a joint body at which the two sides meet.

65 *Construction in the process industries*: our second definition is mainly of statistical value. Large mechanical and electrical construction projects are confined to process and power industries—electricity generation, chemical and petrochemical manufacture, oil refining, gas, steel and non-ferrous metals (including aluminium smelters). To estimate investment in these projects, it was necessary first to collect information about the total capital expenditure taking place in these industries. We then established that about one-quarter of this spending was in electrical and mechanical *site* construction work. The definition of 'construction in the process industries' has practical value: it is used in our forecasts of activity in mechanical and electrical construction in the 1970s. Also, while the value added by mechanical and electrical construction is roughly a third of this investment, the other two-thirds is 'at risk' until construction is complete. A large slice of national investment is affected; currently about £800 million a year or 10 per cent of annual fixed investment.

66 *Large industrial sites*: our third definition is the literal one: large industrial sites are those forty or more multi-million pound industrial projects which are under construction at any one time.* Those at present under construction are shown in the map in Figure 1. Such sites may be distinguished by four characteristics.

67 First, their size: projects undertaken in the 1960s and late 1950s are larger than ever before. In a period of fifteen years power stations have increased ten-fold in size: the latest conventional stations are of 2,000 megawatt capacity, cost about £100 million, are under construction for about six years, and employ a construction labour force, at peak, of about 2,500. Chemical and refinery projects are smaller in terms of investment, ranging from £10–£20 million, but are getting bigger and a £60 million chemical plant is at present being built and a larger one is projected. However they may have a peak labour force of 3,000 or more, though the time span of construction does not exceed three years.

68 Secondly, large industrial sites employ the same skills—mentioned in § 60—drawn from the same labour pool. (In addition to these there will, in the early stages of a project, be workers engaged in civil construction.) Because the demands for labour at a large site are greater than can be supplied locally and because most power stations and many other projects are on 'green field' sites, the need for workers to lodge or travel long distances to work will be great. Furthermore, there is a large casual element, particularly on oil and chemical sites where the large (ie non specialist) contractors regard only a fifth of their workforce as permanent.

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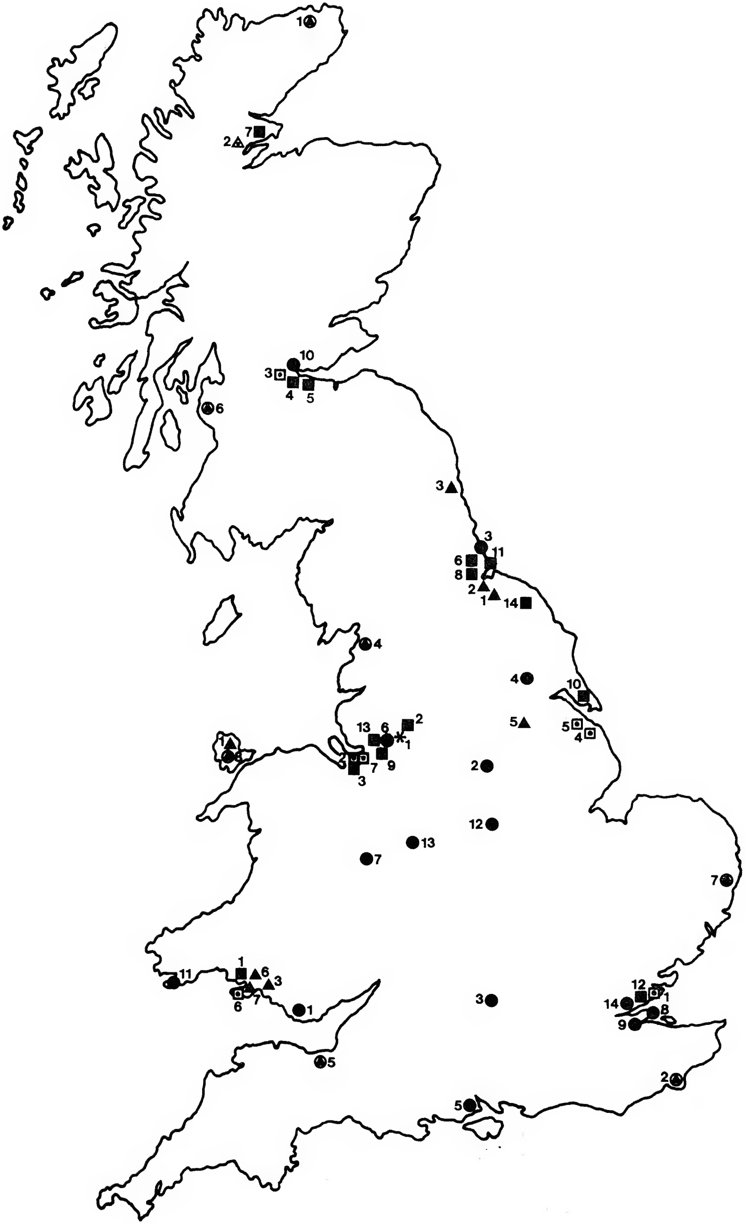
*In a questionnaire to contractors, from which much of our statistical information is derived, 'large sites' were denoted by a list of projects currently or recently under construction (rather than in terms of particular attributes). The list is reproduced in Appendix 2.

Figure 1 Large industrial sites of Great Britain



Large Industrial Construction Sites are those 50 or so multi-million pound projects in the process plant and electrical engineering fields, which are under construction at any one time.
Those at present under construction are shown on this map.

Key to map showing types of site with expected completion dates.

● Conventional power stations

1 Aberthaw "B"	(CEGB)	1970
2 Cottam	(CEGB)	1970
3 Didcot	(CEGB)	1972
4 Drax	(CEGB)	first half 1973
5 Fawley	(CEGB)	1971
6 Fiddlers Ferry	(CEGB)	1972
7 Ironbridge "B"	(CEGB)	1970
8 Isle of Grain	(CEGB)	The Minister's consent has been received but no decision yet given to start main construction.
9 Kingsnorth	(CEGB)	1972
10 Longannet	(SSEB)	1971
11 Pembroke	(CEGB)	1971
12 Ratcliffe	(CEGB)	1970
13 Rugeley "B"	(CEGB)	1970
14 Tilbury "B"	(CEGB)	1969

☢ Nuclear power stations

1 Dounreay	(UKAEA)	1971
2 Dungeness "B"	(CEGB)	1972
3 Hartlepool	(CEGB)	first set by 1973
4 Heysham	(CEGB)	The Minister's consent has been received but no decision yet given to start main construction.
5 Hinkley Point "B"	(CEGB)	1972
6 Hunterston	(SSEB)	1973
7 Sizewell "B"	(CEGB)	The Minister's consent has been received but no decision yet given to start main construction.
8 Wylfa	(CEGB)	1970

* Gas reforming plants

1 Partington	early 1970

⊡ Oil refineries

1 Coryton	(MOBIL)	September 1969 plus further plans
2 Ellesmere Port	(BURMAH)	end 1970
3 Grangemouth	(BP)	1971
4 Killingholme	(CONTINENTAL)	end 1969
5 Killingholme	(LINDSAY)	late 1969
6 Llandarcy	(BP)	mid 1972
7 Stanlow	(SHELL UK)	1969

plus further projects to 1973

■ Chemical plants

1 Baglan Bay	(BP)	End 1971
2 Carrington	(SHELL UK)	1973
3 Ellesmere Port	(ASSOCIATED OCTEL)	End 1970
4 Grangemouth	(BAKELITE XYLONITE)	1972/73
5 Grangemouth	(BP CHEMICALS)	End 1971
6 Greatham	(BRITISH TITAN)	Second half 1970
7 Invergordon	(GRAMPIAN CHEMICALS)	Mid 1972
8 North Tees	(ICI)	1971
9 Runcorn	(ICI)	1971
10 Salt End, Hull	(BP)	1971
11 Seal Sands	(MONSANTO)	Early 1970
12 West Thurrock	(PROCTOR AND GAMBLE)	Mid 1970
13 Widnes	(BRITISH OXYGEN)	1971
14 Wilton	(ICI)	1970

plus further projects to 1975

◬ Non-ferrous metals plants

1 Anglesey	End 1970
2 Invergordon	first half 1971
3 Lynemouth	Early 1971

▲ Steel works

1 Cleveland		1971
2 Lackenby		1971
3 Port Talbot		1970
4 Ravenscraig	Stage 1	1970
	Stage 2	1973
5 Scunthorpe		1973
6 Spencer Works	Scheme B	1971
	Scheme C	1974
7 Velindre		1972

69 Thirdly, large industrial sites are distinguished by the presence of many diverse contractors. A power station may have up to 120 in direct relationship with the client—though the value of their contracts can range from a few thousand pounds to over £30 million. Oil and chemical projects may involve a score of contractors. But even where the number of 'erection' contractors is limited, there will inevitably be a large number of suppliers of equipment.

70 The fourth characteristic is a product of the others: large industrial sites present particularly difficult management problems. Site managers must virtually create a fresh workforce, reach agreement with it on conditions—often a protracted process—attempt to secure a balanced work load and maintain impetus to the end of the project which, when achieved, will (as things are at present organised) mean redundancy for the large majority of the workforce.* At the same time management, whether the client's or a 'managing' contractor's, must ensure that the work of many separate companies is coordinated, and that the stages of design, manufacture, procurement and erection are correctly phased. This is the more difficult when, as is often the case, projects are at the frontier of technology.

The magnitude of delays and increases in costs

71 The extent of delays and excess construction costs in a sample of projects in a number of sectors is given in Appendix 5. Approval for a large project is often granted on a preliminary estimate of costs and time for construction prepared before the project has been closely defined. Nevertheless, the picture that emerges is that in all industrial sectors concerned with the construction of large projects difficulties have arisen which have led to excess cost and lengthy commissioning delays. Since large plants are capable of providing cheaper output they are likely to be a growing feature of the economy: the problems associated with them which we describe will become more serious, if neglected.

72 The consequences of delays affecting power stations are well documented. The power station commissioning programme is running 18 months or so late, while delays of two years in the completion of individual stations are not uncommon. The capital cost alone of one week's delay in the completion of a 2,000 megawatt power station is about £100,000, while the estimated additional fuel costs currently being incurred as a result of one week's delay in a 500 MW conventional generating unit vary between £50,000 and £200,000 depending on the time of year, the weather, and the location of the power station relative to its source of fuel. The costs of delays in other sectors are harder to obtain but there is no doubt they are considerable. Thus the loss of gross profit resulting from a (not uncommon) eight month delay in the completion of a £15 million refinery project might amount to about £2½ million. The delays in a chemical plant's completion is recorded as costing £7 million in terms of the additional imports required. The likelihood of construction delays also carries with it the risk of a greater penalty; that the plant will be built elsewhere. Thus, a report on investment by the Chemical Industries' Association concluded:

> 'The average building time for new plants erected in North West Europe has been shorter than for similar plants in the UK. More important, however, is the great variation that has taken place in the UK. This has made completion dates difficult to predict with confidence. The bad cases have presented a generally unfavourable prospect to international observers, which is psychologically important.'

Causes of delay

73 An examination of the histories of individual projects will reveal a series of factors, often interconnected, which caused delay or escalating costs. Adverse site conditions are often a cause: all outdoor activities are liable to suffer from poor weather, but large sites are commonly situated by the coast and can

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*see Table A.21, Appendix 2.

be subject to extremes of climate and also from sub-soil difficulties associated with the fairly frequent use of reclaimed land. Again, manufacture of process plant in this country is widely dispersed: this sets a particularly difficult task of co-ordinating drawing office and workshop activities of the many hundreds of suppliers which may be associated with a project, compounding the general problem of delivery delays in manufacturing. Material may subsequently be delivered out of sequence, out of specification, defective or simply late. Information—drawings and specifications—also presents its own delivery problems to those concerned with erection. Delays, too, may result in the erection stage from the inadequate provision of site services, and, more important, from shortages of labour of the required skills. Setbacks can occur from the most publicised cause—labour disputes. Since there are a number of contractors on a site each is liable to suffer hold-up or interference or access difficulties resulting from lateness of badly phased work of other contractors. Finally, since construction takes place over a considerable time, designers are afforded an opportunity for second thoughts—an almost certain source of disruption at site level.

74 What is the relative importance of each of these, or other, causes of delay? In our survey among contractors,† respondents selected from a list of possible reasons for delay the four which they regarded as the most important in recent years. The results are given in Table 1.

Table 1 Causes of delay in the construction of large sites

Reason for delay	'Total score'*	% of companies ranking as 1st
Late delivery of materials or plant	180	21%
Late design changes	173	27%
Unexpectedly low labour productivity	120	10%
Labour disputes	88	8%
Delays in subcontractors	79	8%
Skilled labour shortages	61	5%
Faulty materials	24	1%
Faulty workmanship	12	—
Other reasons (which can be reclassified as follows)	89	17%
Other contractors' performance	35	8%
Access	28	7%
Clients' performance	14	1%

*The four reasons chosen were ranked by contractors in order of importance, and were subsequently scored 4, 3, 2, 1.

75 It is perhaps striking that design changes and late delivery scored more heavily than labour problems. We must emphasise that these are subjective views from one group of people—contractors; nevertheless, we consider that as a guide to the immediate causes of delays the emphasis is sound. We discuss methods of controlling design operations in Chapter 1. We suggest they merit special attention. Labour problems are discussed in Chapter 4, while our discussion on the number of contractors in Chapters 1 and 3 have a bearing upon

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†Appendix 2.

the problems of interference and access. Delivery problems, on the other hand have been omitted from our consideration. First, to have pursued delivery problems to their source—through suppliers to *their* suppliers to the availability of raw materials—would have involved following a trail through a large segment of the economy and grappling with general commercial and fiscal questions for which we were not specially equipped. Other bodies have studied or are studying these problems and have made recommendations for improvement.*

76 We did not consider we were called upon to make a precise evaluation of the weight of each factor in causing delays, nor have we tried to apportion blame. The practical difficulty of separating 'causes' apart, our reasons are two-fold.

77 First, we were concerned to look beyond the factors occasioning delays to the features of the environment which favour their occurrence. Thus we believe that certain aspects of this environment can best be improved through consultation at national level, which involves the wider assembly of organisations and interests than have occurred hitherto, though the Working Party has itself been a useful precursor. Accordingly, we make proposals in Chapter 4. But much of the onus will fall upon the client, who, we believe, will need to be more 'interventionist' than has been customary. For a client does not merely buy his plant, but is also (unless he seeks an entire package deal) a manager of those supplying it. It is hardly more realistic for him to assure himself of performance by resting upon legal safeguards than it would be for a manager to discipline his staff in this way. The client must create the confidence productive of good performance (eg by appropriate contractual relationships), clarity and consistency in defining it (by suitable specifications not subject to disruptive changes) and adopt effective ways of monitoring it. These matters are discussed in Chapter 1 (on problems of clients) and in Chapter 3 (on programming).

78 Secondly, our concern is not confined merely to delays and escalating costs, the ways in which plans are frustrated and budgets exceeded, but also with the all too predictable inefficiencies the industry allows for, reflected, for example, in lower labour productivity† than in many other countries. We therefore discuss the qualifications of management in Chapter 2, while in Chapter 4 we examine the reasons for poor motivation and unrest among site workers which together with poor organisation of their work** cause not less than half of their time on site to be ineffective.

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*Notably the Ministry of Technology's Process Plant Expert Committee and the Committee of Enquiry into pressure vessels, which issued reports in 1969, and the NEDO Process Plant Working Party.

†An international company with a worldwide programme of plant construction has developed an index of labour productivity related to a standard location in the USA. It is updated annually by means of a feedback of labour expended on projects and by regular discussions with international contractors who themselves maintain such indices. The following index figures were collated in July 1969

US *Standard location 100*

Various US locations	80 to 110	Italy	80
Various Canadian locations	85 to 110	Venezuela	80
Japan	95	Netherlands	75
Sweden	90	*United Kingdom*	*70*
W Germany	85	Ireland	60
France	80	Spain	55

The UK is placed low in a similar comparison of wage levels.

**We have not examined construction *methods* since we considered that first priority should be given to those strategic problems of the environment which contractors are not able by their own individual efforts to transform. We acknowledge, however, the scope for improvement in methods, and we hope that the follow-up body described in Chapter 5 will be able to study the matter.

Chapter 1 Management by client and contractor

Introduction

79 We are concerned with the delays in building major plants and with the escalation of costs, details of which are contained in Appendix 5. We believe that these in part stem from decisions made by the clients before work on site begins, which set the framework in which contractors operate.

80 We have concentrated here on the critical areas in which the client must make important choices at the beginning of a project. These are:

(a) the form of contract;

(b) the number of contractors and subcontractors on site and the number directly accountable to the client;

(c) the extent of the client's involvement in plant design;

(d) the control exercised over variations;

(e) the penalties and incentives for contractors;

(f) the forms and methods of client supervision.

81 Within these areas the client has certain options. He may, for example, decide on lump sum, negotiated, or on some form of reimbursable contract. He may invite tenders on a design and construct basis, or use his own design teams. Each policy has advantages and disadvantages and each can be appropriate, depending on prevailing circumstances.

82 We must emphasise, however, that a decision in each of these areas cannot be taken in isolation without considering its effects on other policy areas. Policies are interdependent and the intention in one can frustrate the intention in another. The client must seek to devise a strategy of compatible policies. For example, a policy of fragmenting the total work among many direct contractors and seeking competitive tenders has, on the face of it, much to commend it. Given reasonable competition and specialisation it should secure the lowest possible aggregate price. This understandable search for the keenest bids can however, be thwarted by its repercussions elsewhere. As the number of direct contractors directly controlled by a client increases, the task of integrating their work and pinning down accountability increases also. This requires a managerial capacity from the client of a very high order.

83 Any failure on his part to co-ordinate the work or the failure of a few contractors affects the progress as a whole and claims for frustration appear. In such situations maximum competition can make for prices which are merely the starting point for negotiation and the final payment may exceed that which would have been paid under a different policy. Moreover, the concentration on one site of a multiplicity of employers, each with different employment practices and methods of pay for the same skills, exacerbates labour trouble. As a result, the client may find himself forced to abandon his traditional aloofness from the employer/employee relationship of his contractors and use his latent authority to secure some uniformity of pay and conditions. In its turn this will affect the basis of the original contracts.

84 Again because the client wants each successive project to be of a uniform high standard and advanced design, and because he seeks to develop the technology of his industry, he may need to establish his own design teams. The

centre of design thinking and initiative may therefore shift from the manufacturer or fabricator to the client who is the more likely of the two to initiate design variations. These variations not only affect the contract terms but also the accountability for timely completion of work and thus the efficacy of any penalty or incentive.

85 It is because of this interdependence of policies that we cannot recommend a single inflexible formula covering all aspects suitable for all clients for all projects for all circumstances. We do think, however, that for each particular objective and situation, there is an optimum arrangement of compatible policies, and that clients should seek such balanced strategies and be sufficiently flexible to contrive the different combinations of policies that are required for particular cases.

86 We consider that contradictions and inconsistencies between these policies have been one of the reasons for the slow tempo of work on some sites and its rising costs.

87 This incongruity of policy may arise because the thinking of some clients is still tied to the needs of the past. In the last decade projects have increased enormously in complexity, cost, size, and the time span of construction. They have brought unprecedented and baffling problems. Yet it seems that policies have not been redesigned to meet these unique circumstances. We urge most strongly, therefore, that clients now make a searching reappraisal of their present thinking. We hope that the discussion in this chapter on the important questions of forms of contract, number of direct contractors, design involvement, control of variations, and penalties and incentives will help them to make this examination and lead to the balanced and compatible policies that projects of this magnitude require.

Form of contract

88 Even if the working relationship between clients and contractors starts off well it can degenerate, particularly if the contractor faces a loss. This bedevils performance on some sites. We believe it is for the client to take the initiative to establish a satisfactory accord, and here his decision on the form of contract is of prime importance.

89 In our view the crucial decision for plant manufacture and erection work is between a *lump sum contract* or some type of *reimbursable contract*. We pose the arguments for and against each and the circumstances which make for their success.

Lump sum contract

90 We define a lump sum contract as one where the price for the specified work is a stated sum which may or may not be subject to variation by a prior agreed formula, for changes in the rates of materials and/or labour. It is a straightforward approach and the contractor carries the risks. Competition is also demonstrated. Given reasonable competition and specialisation and a very precise definition of what is required and when, it will secure the keenest bids. Contractors also have an incentive to complete the works economically (though this need not be the same as briskly) to make their profit. In the right circumstances this incentive can be very real. Lump sum contracts can also impose a discipline on the accuracy and firmness of both design and specification, in the absence of which the client knows he will pay for the variations he has sponsored, and the contractor must cover himself adequately.

91 Against these benefits we consider that the price factor can be given excessive weight. Estimating is not an exact science and a tender can be optimistic.* A client is not immune to the repercussions. He cannot isolate himself from the risks and losses of his contractors because they affect the progress of

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*Particularly so if the contractor has become used to reimbursable contracts and does not possess a team skilled in preparing lump sum bids.

his work, and the degree of client contractor co-operation. But a bigger objection is that the client must be able to specify his requirements with considerable precision.* He must also reduce to the minimum subsequent variations. Unless these prerequisites are met the contractor will include large sums for the uncertainties in the situation, or put in a low bid and exploit the charges for various frustrations. Thus, where such charges are justified the ultimate total price is fixed by the negotiating skills of the parties, and may bear little relation to the opening lump sum. This persistent sparring for better negotiating positions militates against the effective collaboration that is needed for the design and programming of work. Finally lump sum bids generally take longer to prepare than reimbursable contracts.

Reimbursable contracts

92 We use the phrase 'reimbursable contract' to describe the arrangement where engineering, procurement, and management costs, which include overheads and profit, can be fixed or be a percentage of the material and labour costs and can also be the subject of competition, but where material, labour and constructional plant costs will be reimbursed to the contractor. Sometimes a target cost, time bonus and penalty clause are linked with such variable costs as an incentive to timely and economic competition.

93 Reimbursable contracts are cheaper to prepare than lump sum contracts and generally take less time. Moreover competitive forces are not abandoned. Tenders may still be judged on the quotations for management fees, including overheads, but unreasonably large sums for contingencies are avoided. The greater security of the contractor makes for an easier relationship with his client which is not spoiled by inflated claims for variations. Most important, the client does not have to specify exactly what he wants when he goes out to tender. The contractor has more time to plan and organise his work and his expertise becomes available while designs are being completed. Finally, under reimbursable arrangements it is easier to call on a contractor to make good arrears that he had no part in making.

94 There are drawbacks, however. There is no built-in strong incentive to finish the job on schedule and to the lowest cost, as there is in lump sum contracts. The fixing of 'target costs' requires fine judgement and it has been argued that if sufficient is known about the work to fix a target cost, then a lump sum tender should be invited. This form of contract also requires an unusual relationship between the client and the contractor. The risk is now with the client and in his own interest he must monitor and control costs and progress day by day to an extent which he need not do with a lump sum contract. This extended role requires the client to have a high standard of project management empowered to make needed decisions. Some clients do not have this expertise. Some contractors may be unused to working under such tight control and may find it hard to accept. Perhaps the biggest difficulty, however, is that the client, to protect himself from costs running away, may be forced to intervene in the contractor's labour policies on site. On the other hand the client does not always escape this involvement in a lump sum contract. If there are many contractors, pressures may compel the client to seek some uniform labour policies. Alternatively, he may have to concern himself with a dispute if this threatens his programme, and his intervention may lead to claims for extras.

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*We strongly support a conclusion of the Banwell Report (on the Planning and Management of Contracts for Building and Civil Engineering Works):
'The more that is known of what is involved in any project the less will be the degree of uncertainty against which tenderers will be obliged to make provisions. This applies to all construction work but is of particular importance when contractors are being asked to quote firm prices. Only if the work has been settled in all its critical details is it reasonable to expect a contractor to tender for a firm price and a fixed period.'

95 In reaching a conclusion on the choice of type of contract we re-emphasise that the client's policies as a whole need to be coherent. They must match the needs of the total project and in determining them excessive weight should not be given to the forces of competition. The choice should take account of the many variables, eg the implications for design problems, the urgency of the work, the prospect of variations, the labour situation, and the construction knowledge of the client.

96 We have concluded that lump sum contracts are the most effective form of contract when contractors have adequate capacity, where design can be specified in detail at the outset, where there are stable conditions of labour and materials, where the number of contractors is within the capacity of the client to control effectively and where time permits the preparation of such a tender. Put another way, lump sum may be an appropriate form of contract in situations where variables are few and the extent of their variation small. This would apply to run of the mill work but not to most work at the frontier of technology, which is a characteristic of some sites.

97 These conditions, however, may not always apply in plant erection work on large sites, and it is our opinion that there can be an excessive reliance on lump sum contracts which are used when they are inappropriate. To those concerned with reviewing expenditure we emphasise that the ultimate cost and time of completion of a project and the subsequent performance of the plant is more significant than the amount of original tenders. We also submit that too rigid a policy of a manifest search for the lowest bid can on these projects lead to that increase in costs it is intended to avoid.

98 We recommend that clients make greater use of the considerable range of reimbursable contracts open to them.* We accept that the design of such contracts calls for fine judgement and efficient client control if 'featherbedding' of contractors is to be avoided. The formula chosen must bear in mind the repercussions elsewhere, eg on the method of involvement of the client in the labour policies of the contractor. The consequences of this are examined in Chapter 4 of this report.

Selective tendering and negotiated contracts

99 We have considered the need for a more discerning selection of contractors and the use of negotiated contracts.

100 While it is the practice of the major clients to use selective tendering, we think they should be even more rigorous in their selection. The cost of preparing designs and tenders is high. Ultimately these costs are met by clients. While competition is desirable, an excessive number of contestants is both expensive and an unsatisfactory use of scarce engineering skills. We think it is a mistake to involve many contractors in order to demonstrate beyond doubt that competitive forces have been operating or because it is embarrassing to debar any claimant.

101 But there are other reasons for restricting the number of tenderers. We recommend that clients should first make formal enquiries among approved contractors to discover which of them will be interested in the work. At this stage the client should also probe the particular skills a contractor can offer for particular work—his record in industrial relations, workload, organisation, quality of management, manpower, financial standing and bidding experience, etc. In the light of this information, it is wise to invite tenders from at most four or five contractors. Clients should also consider paying for some preliminary designs.

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*For example, the different elements in a project—process design, detailed engineering, manufacture and/or procurement, and erection—can each be a lump sum or reimbursable contract, and if the latter each linked with a target cost; or each may start on a reimbursable basis and be converted later to a lump sum basis.

102 On occasions this approach can lead to the client deciding to deal with one contractor in whom he has complete confidence, and negotiating a contract. We think that such contracts have their place. Where a client has a steady flow of work negotiated contracts help the contractor to build up and maintain a large number of permanent men, thus reducing his reliance on casual employees (see Chapter 4). In these situations, however, if the client is to negotiate on equal terms with the contractor it is imperative he must have equality of information, and it follows that the client must insist that the contractor reveals essential cost and performance data on past work or have recent market information against which to compare contractors' offered prices. The client should also be in a position to monitor the contractor's expenditure to satisfy himself that excessive profits have not been made. The client will also wish to assure himself of the competence of the contractor's proposed management teams, and he may express a wish for certain individuals.

103 We regret that despite the support by the Banwell Committee for the award of contracts by negotiation there is still distrust of this procedure. We again plead that the commercial judgement of the managers of public undertakings should not be constrained in any way.

The number of direct contractors

104 The working party has considered arguments for and against a client severely limiting the number of direct contractors immediately accountable to him. We emphasise that the client's decision here must be influenced by, and will influence his policies in, other areas. Is he prepared, for example, to maintain the resources for management of the project in detail? Such expertise cannot be built up overnight, and this must weigh heavily when construction programmes fluctuate over the years. Is he able to avoid the variations in design which will disturb the finely balanced programme necessary for the direct control of many diverse activities? Is he prepared to use his latent authority to impose some uniform labour policies on a multiplicity of contractors? Is he ready to take the initiative in providing amenities for the workforce? It is obviously unsatisfactory, for example, for each of many contractors to provide labour camps for their employees.

105 What is at issue here is not simply whether the total work is fragmented between different contractors. This division will to some extent be determined by the structure of the plant manufacture and erection industry and its supporting services. In these circumstances the issue is whether control and direction is better exercised by the client using a large span of control, or through an organisational pyramid the steps of which are: client to a few direct contractors; to subcontractors; to, possibly, sub-subcontractors. The arguments for and against are considered below.

For limitation

106 The larger the individual contract the more opportunity there is for a contractor to make the best use of his resources. As the number of contractors grows, the difficulty in integrating their work increases enormously, and this can reach a stage where the work gets out of control and variations, frustrations and delays are inevitable. With few, 'managing' contractors it is held that the incidence of interface problems is reduced, the subcontractor forming part of a team under the control of the main contractor's management. This arrangement renders unnecessary some of the formal, paper planning of access, etc, by outside, ie client, personnel. Further, the more contractors, the more difficult it becomes to pin down accountability for performance, to impose penalties or award bonuses and to adjudicate on variation claims. Moreover, main managing contractors have an incentive to maintain the performance of their subcontractors because their profit and their future will depend on their total performance; on the other hand, the rewards for success and the penalties for failure applied to the staff of clients do not seem to be so powerful.

Against limitation

107 An ability to organise and co-ordinate work is needed by managing contractors, which many do not possess, and some, at site level particularly, do not apparently want to achieve. It would not pay, therefore, to allow contractors to attempt work beyond their financial and managerial resources. It is also claimed that a main contractor can use the resources of his subcontractors in a way which will benefit him but not necessarily the client, while the interests of subcontractors may be subordinated. It has also been pointed out to us that when consortia have been used it has still been necessary for the client to exercise detailed supervision, and that when contractors have quoted for work ancillary to their main activity they have put in unacceptably high tenders. Finally, it is argued that any client having a large and continuous construction programme is justified in maintaining a permanent 'project' organisation whose experience can be transmitted directly to contractors.

108 We have considered these points of view carefully. We are not, here, concerned simply with the total number of contractors on site, but whether the control and management is better exercised by the clients over many contractors or through a few managing contractors. We have asked ourselves which system will better cope with the setbacks which are bound to occur: there will be variations in design, errors by the planning staffs of client and contractors, and failures by contractors to deliver and erect on time. Unless adjustments are made the difficulties will feed on themselves until, as has occurred, a site degenerates into near confusion. It is our impression that on most sites where clients have restricted their control to a few main contractors, work has proceeded more smoothly than in the situation where no such limitation occurs. Although we are hesitant to draw hasty conclusions because of the presence of other factors we nevertheless consider that the pyramid structure we have described allows a more manageable span of control. If there has sometimes been, as the Wilson Committee* believed, 'too much emphasis on co-ordination and not enough on efficient direction', we consider it partly because of the obligation falling on the owner's management to organise directly the work of too many contractors. We recommend therefore that clients employ only a limited number of direct contractors.†

109 We believe, furthermore, that there is a case for the employment of the specialist 'engineer-constructor', ie the single managing contractor, on large sites. The employment of this type of contractor is common on nuclear and conventional power station construction abroad as well as on oil refinery and chemical projects. It appears to give good results. The chief virtues seen in it by some major clients are that the engineer-constructor has, in addition to organisational skills, design and technical experience which is enhanced by working for many clients, public and private, on many types of site. Their integrated approach encourages the formulation of designs in which the needs of construction have been given full weight. However, the outstanding advantage that can be claimed for such organisations is that they prefer to employ directly most of the supervision and labour on a site.** It is clearly easier to control the work of one's own employees than that of many firms with whom one has merely a contractual relationship. It permits a reduction in the number of contractors at work on site, and hence reduces the extent of differences in pay and conditions

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*Cmnd. 3960.

†A change in policy from employing directly many contractors to very few has of course contractual implications. The conditions in a standard form of contract appropriate for one main contractor may not be suitable for passing on to some of his subcontractors, eg the provisions for labour cost variations for a mechanical engineering contractor may not cater for the situation of a specialist subcontractor engaged by him. This difficulty is not insurmountable, however, particularly if a type of reimbursable contract is used.

**Unlike the British consortia as now constituted.

offered by different employers: fertile grounds for disputes.* There are of course other advantages where a single employer operates over a wide area of like work, eg the ability to use the labour force more flexibly.

110 The choice by a client of a specialist engineer-constructor will in part be conditioned by his construction programme, ie whether it is continuous or intermittent, the extent to which he feels it necessary to be involved in research and design, and his ability to manage a particular project, including its labour aspects, with his own resources. The client should also bear in mind that the use of an engineer-constructor enables him to compare the efficiency in design and construction of his own organisation with that of an independent one.

111 We also believe that the development in the UK of a design and construct capability in the power and process fields, on the lines operating in the United States, could make a contribution to the country's export potential.

112 Finally we recognise that there is a need for the consolidation into larger units of many of the specialist subcontractors and manufacturers, and we support the views on the subject expressed by the Wright Committee.† To some extent the process is already taking place, but it could be hastened by the procurement policies of the major clients.

Responsibility for research and design

Where should responsibility for design lie?

113 There is a range of policies open to the client. He may at one extreme choose to confine himself to drawing up a performance specification of the productive capacity he requires for his market needs. It follows that he must possess the engineering knowledge, or engage engineering consultants able to draw up such a specification, to evaluate tendered designs and quotations and to supervise and inspect work in progress, but the main responsibility for completing accurate designs to a programme rests with manufacturers and contractors.

114 The client may himself draw up, or again use engineering consultants for, the layout of the various process units and their supporting structures including pipework, cables and other services, and require manufacturers and contractors to design the sophisticated plant for this layout to certain performance 'duty' specifications. He then has the responsibility of integrating the contractors' designs in one scheme and *doing this to a rigorous timetable.* It is obvious that he must maintain or engage a greater engineering capacity than when he decides on a performance specification described in the preceding paragraph, and a substantial responsibility for the total design process has shifted to him.

115 At the other extreme he may go beyond devising a layout and provide contractors and manufacturers not with a performance or duty specification for plant, but with what is in effect a product specification in which he will spell out in great detail every step in the particular process. Thus he takes to himself the design of the plant. It follows that the client must not only maintain considerable engineering resources, but he must be involved in development and research in certain fields if his plant is to incorporate the latest technology. This policy may be necessary where the client has exclusive knowledge of some specialised process and where he may be the licensor. He may operate on a global scale and he alone may be able to afford the necessary research in certain fields.**

116 Again we revert to the interdependence of the client's policies. If he decides to divide the work among many direct contractors, then he must engage engineering resources for planning of the layout and for the integration of design; the

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*see Appendix 3, § A.124–A.128.

†Report of the Process Plant Expert Committee, July 1969.

**National undertakings, however, may best accomplish this by sponsoring research work in manufacturing companies, or awarding design-only contracts.

greater the division of work, the more difficult becomes the task of integration. If he wants to retain surveillance of design activity up to a late stage in the project, then the form of contract he chooses must be such as will accommodate this. If he wants to confine himself to broad specification then the case for his employing an 'engineer-constructor' becomes stronger. It will be seen that there is no one simple formula suitable for all clients for all of their projects. Their circumstances will influence the extent to which they become involved in the research and development of the plant they use and thus the extent of their involvement in detailed design.

117 However, the more clients, for the reasons mentioned, choose to take the technical initiative on certain matters of design, the more they, rather than the contractor, become responsible for the result. In seeking involvement in design the client, too, should take special care to avoid the serious shortcomings sometimes associated with this policy, the chief of which is a tendency to 'polish the apple', ie to introduce at a late stage numerous small improvements which can have a far reaching effect on a project's progress and hence its cost (see § 120–127). There must be clear definition of the responsibility for detailed design as between clients and contractor, and acceptance that there are points in time, eg the award of a lump sum contract, at which direct clients' responsibility for design should cease. After this point continuing concern by the client with details of design can thwart progress and be justly described as interference.

118 We also ask clients who contemplate the maintenance of design resources to bear in mind that for certain plant, whatever the policy of the client, the manufacturer must maintain a research and development capacity of his own if he is to compete in other markets. It is unlikely that the formulation of plant design will fall into two tidy divisions between the clients' and the manufacturers' design staffs. There will be some overlapping, some problems of communication and questions of who decides what. Thus total design resources used by both client and manufacturer together must increase, and duplication can contribute to delays in design programmes. Do the end results justify these disadvantages? Finally, the more a client's participation in design increases, the less the contractors' experience and knowledge of construction problems and requirements will be brought to bear at the design stage.

Basic engineering standards

119 We have also examined the way in which clients use and maintain basic engineering standards for their plant. Such standards are intended to serve two purposes: to ensure uniformity of equipment purchased in different contracts, thus simplifying maintenance and limiting the size of replacement stocks; and to obtain an adequate standard of workmanship and materials. While standards are thus necessary, it seems that they can become too voluminous and too detailed. This proliferation can become an unnecessary restraint on contractors' design teams causing queries and friction, and therefore an impediment to the timely completion of detailed drawings. We recommend that clients from time to time examine critically their basic standards, cutting out the irrelevant or unnecessary. This should also reduce the amount of detailed and unnecessary checking of contractors' designs, a process which can permit junior engineers to delay urgent design programmes. We also recommend that where possible use be made of 'universal' standards. Certainly, the more a company has to 'buy in' its technology, the greater the case for 'open-ended' specifications to contractors or manufacturers. We also consider that a client should exercise greater control over the ways design criteria are changed. They should be subject to freeze dates in the same way as actual designs, and should not be subject to what could seem to contractors the whims of newly appointed engineers or consultants.

Design delays and variations

120 We are impressed by the evidence of the questionnaire to contractors (see Appendix 2) which indicates that late design information or changes in design is recorded by contractors as the most serious single cause of delays in projects. (This is not to suggest of course that contractors themselves are not also responsible for similar failures.)

121 The completion date of a plant is often, in the private sector, dictated by the need to seize a market opportunity, while in power station construction in the 1950s and early 1960s the necessity of making good the backlog of capacity led to the compression of the planned period of construction (even though units grew greatly in size). Both factors have encouraged the practice of permitting considerable overlap of the design and the erection phases of projects. At times, however, the results have been unsatisfactory; thus it has happened that site managers have had to suspend work through lack of drawings, and this has brought about enforced idleness and both loss of morale in the workforce and loss of momentum which is difficult to regain later.

122 We would give our support, therefore, to any steps to achieve a greater separation in time of design and construction.* This would be facilitated by the use, now favoured by public undertakings, of two-stage contracts in which design of major items of plant is commissioned from the manufacturers without further commitment, the completed design together with manufacture and erection being left as a second stage when government authority to proceed on a particular site has been obtained. It would also be brought about if more manufacturers were encouraged to develop their own specifications and were thus able to offer their own standard equipment, in the way that is customary in the United States, to buyers at home and abroad.

123 Design variations, too, can be a serious impediment to the timely completion of work, and can be very expensive. They are a cause of protracted disputes between clients and contractors, wasting scarce design skills. Some variations are inevitable. No project is ever a replica of another. An original specification can be inadequate, or there may be some mistakes in design. Safety considerations or the experience gained on the operation of an earlier plant may make some changes essential. There is a strong feeling among those concerned with construction, however, that many of the variations are not justified by any of the above criteria or by rigorous evaluation, but are adopted because of their attraction to individual engineers, and because of a search for technical perfection with scant regard for the economic consequences.

124 In view of the unanimity of opinion within the industry on this subject, it seems puzzling why this problem should persist, particularly when all the major clients insist they have adequate machinery for controlling variations. Although many variations are made by contractors we believe that the control of variation lies mainly in the hands of the client, particularly when he has decided to manage the project and its design himself.

125 There often seems to be a real discrepancy between what a client organisation believes to be and puts forward as its control system over variations, and what actually happens. It seems likely despite the absolute authority ostensibly given to project management, that both those who are concerned with long term development and those who will subsequently operate the plant exercise an unregulated but nonetheless real and direct authority.

126 There should be a specific discipline for the approval of variations of different magnitudes at different levels in the clients' organisations. Although difficult, it is imperative that the effect on subsequent work and delays in commissioning should be taken into account. Delays cost money in capital

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*We recognise, however, that procurement of long-delivery items before completion of plant design is often justifiable.

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charges, in the use of old and uneconomic plant, and in the possible loss of markets. Some clients are content to evaluate variations in terms of capital expenditure without fully calculating the costs of delay—interest charges, loss of output etc. A variation involving a delay would need to have a substantial effect on operating efficiencies to be justified in economic terms.

127 In some client organisations, management of a project is spread between engineering and contracts departments. The engineer will give instructions on a variation although no prices are agreed at the time between him and the contractor. This may happen because of the urgency of the situation, or because it is impossible for both parties to agree to an estimate. But in any case the engineer is not empowered to fix the price and it is the contract manager who eventually negotiates with the contractor. We doubt if a satisfactory system of cost evaluation is possible under this division of authority and responsibility.

Penalties and incentives

128 Most contracts contain a penalty clause. It is, however, extremely rare for them to be enforced despite failures to complete work on time, because failures can rarely be demonstrated as being the fault of a particular contractor. A client may introduce modifications which disturb the programme, there may be errors in design for which the contractor is not responsible or a contractor's work may be impeded by other contractors. Also when a project lags behind programme difficulties multiply. These difficulties may not be attributable to a particular contractor, but can affect his work in a way which neither he nor the client could anticipate. In such circumstances it becomes impossible to apportion blame. These disadvantages apply also to penalties in subcontracts, where the allotting of an equitable amount of liquidated damages among subcontractors presents a further difficulty.

129 For these reasons we have concluded that the presence of such clauses in a contract rarely influences the efficient dispatch of work. Indeed it has been emphasised by contractors on the working party that a more effective sanction is the fear that failure by a contractor will jeopardise his future selection by the client. Contractors also emphasise that the real threat of a penalty not only reduces co-operation between a contractor and his client but also between contractors on the same site as all parties manoeuvre to avoid blame.

130 Contractors also point out that if penalties could be more strictly enforced then inevitably tender prices would be increased as a form of insurance.

131 Clients, however, while well aware of the limitations of penalties, are reluctant to disregard tradition and dispense with penalty clauses which they regard as a necessary spur to contractors. They are also aware that no penalty obtained from a contractor would be likely to compensate for the losses from commissioning delays.

132 Because of these limitations some clients now think that offering extra payments for good performance is more likely to stimulate efficiency than penalties for bad. Some inducement for timely completion is often necessary. No programme runs exactly to time. There are unforeseen impediments and the acceleration of work may require extra expenditure on for example the hire of additional plant and special rewards to supervisors.

133 Such incentives can be viewed as a form of penalty. The forfeiture of a bonus as with a penalty reduces the contractor's expected profit. They are, however, more acceptable and can be applied more easily. They also have the advantage that unlike penalties they can be introduced at any time during the contract (although this may be the exception rather than the rule) as an inducement to quick completion, to clear a bottleneck or for the achievement of specific goals, eg for timely completion of drawings or delivery of equipment to site, and to cover special circumstances outside the control of contractors. If awarded to a firm the problem of apportionment must be resolved. There is a

strong case for allowing managers and supervisors to share in a bonus, and an arguable one for rewarding subcontractors and component suppliers.

134 There is not always scope for such bonus payments. On a multi-contractor site there is little point in the client offering a bonus to one contractor for speedy completion if his part of the project is not critical for the programme as a whole; he may moreover in so doing incur unnecessary interest charges. The client must also have adequate supervision to avoid a decline in the quality of work as the pace of work increases. In the same way that failure can be outside the control of the contractor so too success may not stem solely from his efforts.

135 The client's policies are interdependent and the approach to penalties and incentives must be compatible with his policies elsewhere. There seems little point in a client proposing either a penalty or an incentive unless he is prepared to establish the environment within which they can be an effective spur. Only if the contractor is placed in a situation where his performance is directly attributable to his own efforts are either penalties or incentives relevant. It follows that the client must be prepared to exercise a rigorous control over variations, to establish a precision of design, and clarify his part in the design process, and also, if he is managing the site, to integrate effectively the work of different contractors. And, as we point out in § 106, the fewer the contractors the easier it becomes to pin down accountability for their success or failure. To persist with incentives or penalties where these conditions are not met has little value.

136 We have concluded that the offering of extra payment for special performance has an advantage over requiring payment for bad performance, and is more likely to stimulate efficiency, but only when these conditions are met. It is our view that the manipulation of incentives and penalties has little to offer to the solution of site problems. Marginally they may be useful but they have no real bearing on the questions of organisation which we regard as fundamental.

Site services

137 We have enquired to what extent inadequate site services—access roads, hardstandings, storage areas, buildings, scaffolding, power, drainage, lifts, craneage—contribute to delays in construction. We consider that they do not often constitute a serious problem—delays so caused could be measured in days rather than in months, and we have formed the impression that services have improved in recent years.

138 However, inadequate provision of stockyards or storage buildings can have important cost implications. Thus, for example, a firm of structural steel erectors was provided with such a small storage and handling area that the consequent difficulty in sequencing material at his depot and in working 'hand to mouth' at site added one-third to the cost of the contract.

139 More commonly, lack of definition of services to be provided in contract documents causes misunderstandings and frustration. We feel the onus for definition should lie clearly upon the party inviting tenders (whether a client or a prime contractor). Failure to do so, if it does not tempt tenderers merely to assume conditions favourable to themselves, obliges them individually to draw up their requirements in a non-standard manner thus introducing complications into tender evaluation. As standard forms of contract are silent in this area, we recommend that invitations to tender include a 'scope of work' section which will specify, or offer alternative arrangements for, the services mentioned above. The use of imprecise expressions like 'all reasonable provision', 'suitable facilities', should be avoided. We also commend the practice of those clients who insist where possible that tenderers visit the site before contracts are signed to gain an impression of working conditions. In any event, time taken in pre-contract discussions amply justifies itself in avoidance of post-contract disputes.

140 Contractual matters apart, poor allocation of shared facilities has given rise to unnecessary conflict. We recommend, in particular, that clients, or managing contractors, should take the trouble to arrange the fair allocation of cranes, and to provide lifts, with attendants, for as many men working above ground as possible. Where this means using a client's permanent installations it may mean acceptance of the need for reconditioning when construction is complete.

Clients' project teams

141 We now consider the organisation which a client maintains or engages for supervising design, procurement, and construction of a plant. Naturally, the scale and frequency of different clients' construction projects and the extent to which clients are involved in plant design will influence the form of project management. Clients with a continuous building programme are more likely to retain a permanent organisation incorporating many skills than those whose building programme is sporadic. These clients are more likely to assemble a project team from their operating and technical departments, or alternatively to employ consultants or a managing contractor, but here the client can be expected to monitor progress and also usually the quality of the work.

Project management

142 We turn first to the question of the authority of project management. The manager's authority is not simple to assess. There may exist a formal definition of his responsibilities and power, but even so it is unlikely fully to describe what he regards as his area of competence, which is the product of personal relationships as well as the rule book. Nevertheless, a good indication of the authority of a manager is given by the financial powers he is said to possess. In this regard, we note remarkable differences in the rules of different organisations governing the amount of expenditure a project manager and his subordinates, the site managers or resident engineers, can authorise.

143 We are referring here not to the initial letting of a contract but with expenditure which is necessary during its course. Expenditure may be required, for example, to put in hand extra work to remove bottlenecks, and a contractor may have to make exceptional efforts to recover arrears for which he may not be responsible. Such work can easily be accommodated under the terms of a reimbursable contract, but the need to spend money in order to save time will also undoubtedly arise where most contracts are on a lump sum basis. The public undertakings (which rely to a greater extent on lump sum contracts than other clients) generally place greater financial restraint upon their project managers than do the private companies. The difference becomes more marked at site manager's level, ie from a limitation of £100 at any one time, to working flexibly within a large contingency allowance.

144 It does not seem that considerations of public accountability require severe constraints on managers' authority. For example, a superintending officer controlling a contract for the Ministry of Public Building and Works (equivalent to a site agent) has discretion to vary the amount spent on a contract, in order to overcome unforeseen site conditions or problems affecting construction, on a sliding scale. For contracts between £67,000 and £1 million he is allowed 7½ per cent, with a ceiling of £75,000 for all contracts over £1 million.

145 We do not wish to overstate the significance of rules governing financial authority, but we consider that they can, through the need constantly to 'refer back', inhibit decisions and undermine managers' authority and standing with contractors, while the divided responsibility that they entail weakens personal accountability, which we regard as the most effective spur to efficiency. We recognise also that *contractors*' site management are sometimes hampered by inadequate financial authority.

Project management and site management

146 Secondly, there are the relationships between project management (whose concern with the project extends from the letting of contracts up to commissioning) and site management. In some client organisations, both public and private, the site manager and his staff of subordinate, 'sectional', engineers are not appointed to the project until site work begins. Thus they take over the site aspects of a project without any involvement in the decisions on design, layout and sequence. This situation, we believe, can lead to design of plants which pays insufficient regard to construction problems; to the letting of 'split' contracts which multiplies the difficulties of co-ordination of contractors' work; and to the management of site operations without the sense of urgency that a full appreciation of the commercial implications would instil.

147 Some clients attempt to interchange engineers between sites and headquarters where possible. We consider this highly desirable. One major client goes further. Depending on the size of project, a number of project engineers are appointed, reporting to the project manager. The plant, where size justifies it, is divided as far as possible into separate blocks of design activity, to each of which a project engineer is assigned. At the design stage he is located in the contractor's office, and is concerned with monitoring the contractor's engineering and purchasing operations. When construction begins the project group moves to site, the project engineers then becoming field engineers. Thus they are responsible for monitoring the construction of the plant in whose design they were involved. Doubtless there are difficulties: engineers good at checking designs will not necessarily be the best at supervising site activities; problems of housing and schooling arise (as they do indeed for contractors' employees). But we think the policy, which has worked well in practice, is a sound one—some continuity is preserved and wide experience is gained by the client's staff—and we commend its wider adoption. Failing this we think that the project manager should be located on site for as long as possible during construction. We recognise, however, that this will be easier to arrange the more the design and construction phases are separated.

Project managers and specialists

148 Finally, there are the relations between project management and specialist staff. Most client organisations with which we are familiar appoint a management team to oversee their projects from the issue of contracts (sometimes earlier) to commissioning of plant, though the degree of autonomy enjoyed by the teams varies. In some organisations this is virtually complete, subject only to the necessity to gain the approval to major alterations in design or cost of the board of directors or of senior operating staff. Such technical or design expertise as the management team itself does not possess is engaged from inside the client organisation or hired from consultants or contractors. In other organisations some decisions must be referred to outside or headquarters' staff, eg to central design departments or contracts departments.

149 Some clients, in private and public sectors, call for greater devolution of authority upon central departments, or are contemplating it. These clients doubt whether it lies within the capacity of a single manager—a 'Poobah'—with whatever technical advice, to make the best decision over a diverse range of technical matters, and that it is preferable to give executive responsibility for different engineering areas and for site layout, etc to central, functional departments, the project team being retained only to monitor performance on time and cost. In the opinion of others, no project is so large or complex that it cannot be best controlled by a single management team under one man—normally the project manager.

150 In this, of all areas, we would not be dogmatic. The success of a 'departmentalised' approach will depend upon the quality of the monitoring processes. Nevertheless, we consider that there are dangers in transforming the project

manager into a project co-ordinator. Someone with knowledge of the complete project must be in a position to take decisions in which the advantages of pursuing the best from an engineering point of view are balanced against the penalties of late completion. It is possible, of course, for such conflicts to be resolved at a level higher than the project team, but it would be wrong, we think, to imagine that these conflicts would be infrequent. Moreover, the numerous problems with design implications which tend to arise at site—the results of incorrect or incomplete drawings, faulty manufacture, or the need to overcome an erection difficulty—would be less likely to receive speedy solution from autonomous design departments than from site staff's own superiors, the project management.

151 The majority of us consider that other forms of organisation are unlikely to reproduce the distinct advantages associated with management teams having continuous and exclusive concern with the completion of a project to a cost, to a time and to be a specification. Specialists in the team may certainly maintain functional links with their 'discipline' departments in order to obtain the benefit of their colleagues' skill and to promote uniformity of practice. In such teams, however, there is more likely to be acceptance of the dangers of straining after technical perfection and of the compromises and risks inherent in management.

152 Finally we wish to emphasise that those who bear risks must be adequately compensated. We end this chapter, therefore, with a plea that clients' project management should be rewarded in a way that reflects the value—running up to £100 million—of the undertakings they supervise. We doubt whether some existing salary scales permit this.

Chapter 2 Training

Management training

Qualifications

153 Too little use, it is said, is made of modern planning techniques, work study and of budgetary control.* Certainly our own investigations point to shortcomings in planning (Chapter 3), while our Survey among Contractors (Appendix 2) reveals that four contractors out of five (including many large companies) employ no full time work study engineers on site. Though much management expertise can be acquired on the job, there is a need for certain techniques to be taught in a systematic way. We commissioned a survey of training courses suitable for management in the industry; this showed that while there is a wide range of courses covering different techniques in construction management generally there is a dearth of courses specifically designed for management in mechanical construction.†

154 We believe there is a need for courses tailored to site management needs, and we hope that the new groupings of employers and clients we suggest will jointly promote such courses with selected colleges. A permanent association between the industry and an academic institution or institutions is most desirable.

155 This could of course be helped considerably by the relevant Training Boards. We regret that we have to refer not to one Training Board for the industry but two, because the contracting firms in this industry are divided between the Construction Industry Training Board (CITB) and the Engineering Industry Training Board (EITB). We think this division is unfortunate. It can lead to differences in policy and methods of sponsorship. Another objection is that because the industry falls between two Training Boards its special interests as an industrial entity can be neglected. We urge that the management training requirements of companies in mechanical and electrical construction should be handled by a single board. We think this should be the CITB, which is concerned with construction, advised by a committee drawn from the industry. We realise that contractors both manufacture and erect and that their manufacturing activity is properly within the scope of the EITB, but we are sure it will be possible to devise some arrangement whereby the CITB covers the plant erection divisions of such firms.

156 We have not concerned ourselves with the formulation of training programmes or with the examination of the jobs of various levels and types of management that must precede it. This is because the Oil and Chemical Plant Constructors' Association (OCPCA) with the support of the CITB, has commissioned a study of managerial roles in a representative cross section of their member firms. The resulting analysis will facilitate the design of the special management courses we desire. Since we believe that the problems of managing mechanical and electrical operations on site are fundamentally similar irrespective of whether the end product is on an oil refinery or a power station, we are anxious that the investigation should be extended to cover firms (mainly

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*This is said, equally, of foremen: *Survey of Training needs (Operatives) for* OCPCA, CITB p. 55.

†We note, however, that the Heating and Ventilating Contractors' Association and the Electrical Contractors' Association have, for a number of years, been running management courses and latterly, courses for foremen. Individual engineering construction firms, too, with the help of consultants have formulated internal training programmes.

operating on power station sites) who are administered by the EITB. However, as the EITB were not prepared to carry out a parallel study, we invited NEDO to sponsor a study among a representative sample of companies within the scope of the EITB. The results should be available in October 1970 and should help in the drawing up of a coherent training programme for the plant construction industry.

Status and rewards

157 The lack of courses specially designed for mechanical construction implies a further serious failing: there is no concerted promotion of this work as a worthy and rewarding career. As a client has put it, 'All types of people in our organisation go through construction, but they don't want to spend a lifetime at it.' This casual regard for the function stunts professionalism; it stands, moreover, in contrast to the esteem enjoyed both by their counterparts in the United States, but also by civil engineers in this country. This is a matter perhaps for the training and professional institutions—but it is not unrelated to pay.

158 At the moment managers and foremen on site frequently earn less than the average earnings of the operatives they are managing. This is inequitable, offers craftsmen no inducement to accept promotion, and should be remedied.

159 We conclude by drawing attention once more to a commonly observed confusion of accountability and authority, flowing from untidy management role structures. What is expected of managers and the authority they need to achieve it needs clear definition. Sometimes those who ostensibly hold authority are thwarted by de facto decision-making in other departments. We urge contractors and clients to scrutinise their organisations for this common defect. Its prevalence could annul the benefits of improved training.

Craft training

The background

160 Historically, apprentice-trained men from other sectors have provided the bulk of craftsmen for mechanical and electrical work on large sites. It may seem surprising that the industry has no established comprehensive internal training system, or any clearly recognisable promotion pattern providing opportunities for tradesmen to develop their managerial potential.

161 There is a body of opinion which considers both feasible and desirable the establishment of apprentice training schemes in which recruits gain their experience largely, if not entirely, on site. At least one major mechanical fabricator and erector has installed such a programme, and reports favourably on its progress. Nevertheless, many continue to doubt the practicability of comprehensive on-site training for green labour, save in the case of rigger/erectors.

162 The kernel of the problem consists in the very nature of large site construction—the limited life of any one project; site conditions that are in many ways the reverse of those in the average works where apprentices normally gain their experience, and which lack even the relative consistency of employment and routine offered by the local electrical contractor who recruits school-leavers for training. These irregularities militate against satisfactory completion of apprentice training under site conditions—apart from the question of whether it is desirable to have people under eighteen years of age employed in that environment. On account of these difficulties, this industry will continue to look to others for recruits qualified to normal craft standards, at least for some years to come. The scope for innovation will lie in turning tradesmen from other sectors into competent site craftsmen.

Existing training facilities and the CITB report

163 The Department of Employment and Productivity provides training at 42 Government Training Centres (GTCs) throughout Great Britain. Courses of six to twelve months' duration are available in some trades basic to mechanical

and electrical construction—electrical installation, plumbing, fitting and welding. The primary task of the GTCs is to train unskilled men for new jobs, but courses are offered to promote semi-skilled workers to skilled grades, enhance the capacities of skilled men, or to convert a tradesman's existing skill into a new one. GTC trained tradesmen have been recruited by companies for site construction work, but some employers consider that the average standard of competence achieved was below their requirements. However, this might be the result of a misunderstanding by the employers of their responsibility—they were expected to give GTC tradesmen additional training on appointment.

164 Some progress has been made toward establishing organised training courses for rigger/erectors, who are essentially construction site tradesmen. The Water-Tube Boilermakers' Association and the Constructional Engineering Union (CEU) negotiated a three-year, on-site improver training scheme in 1965, which it was hoped would cater for 200 improvers a year. Though recruitment has not hitherto been as high as expected owing to the reduction in large power station contracts, some 250 improvers are currently receiving training under the agreement. Advantage has been taken of off-site training at the Construction Industry Training Centre at Bircham Newton, where good results have been achieved on two-week courses.

165 The Bridgebuilding and Constructional Steel Erection Industry have also completed negotiations with the CEU for the establishment of a training programme along similar lines.

166 The situation is more favourable for welders; given that a man has undergone the basic craft training, there are sufficient further training sources available to the CITB to cater for the industry's needs.*

167 For pipefitters, millwrights, boilermakers/platers and electricians the position is far from satisfactory. There is a dearth of training schemes designed to equip craftsmen for the specialised work encountered on large construction sites. The CITB, however, are planning to proceed with experimental courses in pipefitting, without delay, and to provide for the other trades in due course. Courses are starting at the GTC, Enfield, for electricians early in 1970, and for erectors later in the year. It is believed that systematic training, supported by method study, might reduce the learning time for many tasks by up to 75 per cent.

168 In addition to the primary construction crafts under consideration, other skills, particularly those of scaffolders and crane operators, play a leading part in site work. The need for training in these operations has been recognised by the CITB, and the Bircham Newton Centre is already providing courses which, linked to on-site experience, enable a worker to progress from novice to scaffolding supervisor in three years.

169 The most comprehensive review of the present situation in operative training available is the CITB *Survey of Training needs for the Oil and Chemical Plant Constructors' Association*, based on a survey carried out on four oil refinery sites and a steelworks during the spring and summer of 1969. In the course of the investigation interviews were held with 187 craftsmen and craft foremen, and a selection of managers, superintendents, and shop stewards, making a total of 237 persons.

170 Information provided by this sample reflects the reliance of the industry upon others for its supply of trained craftsmen, and also highlights the fact that the knowledge which new entrants have gained in other sectors is generally inadequate; that is, considerable site experience is required before the majority can be considered proficient 'oil and chemical construction men'. (The same is true of those new to power station and other major construction works.)

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*CITB report, *Survey of Training Needs (Operatives) for* OCPCA, p. 73.

171 Table 2, which gives a breakdown by trade and previous experience of 173 craftsmen interviewed by the CITB team, illustrates the first point made in the previous paragraph.

Table 2 Background of 173 site craftsmen

Trade	Building/ constructors	Shipyard/ dockyard	RN/MN/ dockyard	Engineering	Others
Pipefitter	26	6	—	—	12
Rigger/erector	14	—	21	—	5
Welder	2	13	—	—	14
Boilermaker/plater	1	11	—	—	8
Millwright/mech. fitter	—	2	—	9	8
Electrician	18 (Contracting)	2	—	—	1
Totals	61	34	21	9	48

172 Table 3, from the CITB Survey, emphasises the second argument of § 170.

Table 3 Improvements in the proficiency of 173 craftsmen following site experience*

Trade	Per cent tasks known on entry	Per cent tasks known now
Pipefitter	36·5	71·0
Rigger/erector	54·7	73·5
Welder	64·4	74·4
Boilermaker/plater	77·0	93·4
Millwright/mech. fitter	54·5	86·5
Electrician	69·8	100·0

*The changing percentages do not denote improvements in unit time, but in average time taken over the total experience of the individuals in question.

173 As the investigators noted, proficiency levels on entry to the industry are not indicative of high initial proficiency among pipefitters, rigger/erectors, welders and millwrights. Electricians, whose apprentice training is usually of a high standard, appear to adjust themselves to their new tasks more rapidly than do pipefitters, riggers and welders.

174 Where proficiency still remains relatively low after several years' experience, the major causes are the lack of training schemes, high turnover of labour (200 per cent per annum among craftsmen in the recent experience of some member companies of OCPCA; a factor which must be taken into account when considering the magnitude of any future training effort), over-manning, and other anomalies resulting from the general instability of the industry.

Some problems in establishing training programmes

175 While an encouraging measure of agreement is emerging among the craft unions and the larger employers regarding the key role of systematic training, the mechanics of installing schemes will require the maximum of co-operation and good will if early progress is to be accomplished.

176 Many issues remain to be decided: what parts are to be played respectively by the CITB and the EITB? This may present real difficulty for firms who both fabricate and erect and at present pay levy to the EITB. We have already suggested that all erection work should be in the purview of the CITB.

177 Should trainees be judged by course assessments or formal tests, and if the latter, who are to be the examiners? Employers, clients, City and Guilds, Training Boards? What part are the unions to play in this? Though the outcome of discussions and negotiations within the industry cannot be prejudged, it seems desirable that examiners should constitute, or be drawn from, a recognised independent body.

178 Can the 'sandwich course' concept, already utilised for graduate and other engineering trainees, be extended to include craftsmen, and can the CITB be fully responsible for the inauguration and implementation of such a programme?

179 Divisions of opinion exist concerning the linking of wage increments to examined or assessed gradings; two basic points of view have been expressed, the first being that pay differentials should be the principal factor encouraging men to widen their range of skills, the second that improvements in proficiency should be seen as supporting the craftsman's claim to be master of his task and thereby to qualify for a craftsman's rate of pay, rather than yardsticks for classifying 'degrees' of craftsmanship by varying wage rates. If the first line of thought is accepted, it will be asked, for example, how site agreements in their present form could be reconciled with grading and testing schemes. Care would certainly have to be exercised in introducing any controversial skill differentials in the early days of formal training projects. We wish to remit the question of differentials—essentially a matter for negotiation—for serious consideration by the industry: preferably by the joint Council proposed in Chapter 4.

Training for better industrial relations

180 On the widest training front, it is clear that a great deal of work is required to improve site industrial relations. Communications between employers and full time union officials, shop stewards, and workers, and among union representatives and their members, are frequently very poor and the notoriety achieved by certain sites in recent years as a result of almost total breakdowns in normal negotiating processes speaks for itself.

181 Evidently a thorough overhaul of the machinery is required if the endemic mistrust which prevails on both sides is to be reduced. Among many feasible innovations would be better facilities for stewards to carry out their work on site; comprehensive training in site and other agreements for stewards and junior supervisors, which might be extended to include the bulk of the labour force; the education aimed at gaining ready acceptance of new construction techniques.

182 There seems to be no objective reason why courses in the practice of industrial relations available to stewards and managers in other sectors should not be adapted to the requirements of mechanical and electrical constructors. The precise working of such schemes would of course be a matter for negotiation between the employers and the unions, as would their respective contributions, but it is reasonable to expect that a consistent effort in this field would pay handsome dividends.

Chapter 3 Programming

Introduction

183 Techniques for the control of projects have improved substantially over the last two or three years. In some areas this can be attributed in large part to the work which culminated in the symposium organised by the Central Electricity Generating Board (CEGB) in late 1966 on Programme Management of Power Station Construction.* Since then, the CEGB and the Water-Tube Boiler Manufacturers, in particular, have been active in the improvement of planning methods and transmission of information between clients and contractors, and between contractors' site management and their site engineering staff and subcontractors. This is an area, therefore, where rapid change is taking place but where to some extent practice lags behind precept—possibly because many projects were in hand before the proposals of the symposium gained acceptance.

Initial planning

184 Planning by the client usually begins with a single, broad-scale plan, usually in network form, embracing design, manufacture, procurement, erection and commissioning. Dates are allotted to certain 'milestone' events, and these should become incorporated in the tender documents. The requirement by the client that the tenderers should agree to meet these intermediate or milestone dates is becoming more usual. We strongly recommend that contracts should specify not only final completion dates but design, procurement and stage construction dates.

185 Contractors are usually required to submit a more detailed schedule of dates within 2 or 3 months of receipt of a contract letter or letter of intent. We consider that in most cases networks can better show the viability of the contractors' proposals and give evidence that he has considered the implications of the promises he has made—and that this is so regardless of the size of the contract and the detail that is required.

Planning of design activities

186 We note that the CEGB symposium referred to above said that:

> 'The development of (design) programmes lags considerably behind the development of programmes for manufacture and construction. Design/decision programmes appear to have been prepared with a lack of real appreciation of the interrelation of events and also there appears to be a poor appreciation of the delays resulting from late decision-making and changes of heart.'

187 We would consider three years later that although the techniques for controlling the design activity are better developed, there remains a greater reluctance to use them than procedures for the control of work in the factory or on site. One recent researcher noting this reluctance among design engineers compared it to the attitude of an artist refusing to admit that there was an inevitability about his final product, and so its attributes could hardly be put down on paper before all had been completed.

188 Some companies use a bar chart to indicate, clearly enough, who is responsible for an activity and what date it is due to finish. Its shortcoming, however, is that unlike a chart in network form it does not show the interaction of activities well enough for delays to be predicted accurately. Users of bar

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*Since published by the CEGB, distributed by Basil Blackwell.

charts for design scheduling appeared, in an investigation undertaken on our behalf, to be at the limit of the usefulness of their method, while those using networks seemed able to maintain control of progress.

189 Some clients have been successful in encouraging their contractors to use advanced methods for programming site work: in view of the particularly damaging effects on progress that can arise from late design information, we urge that this process should be vigorously extended to the drawing office.

Detailed plans and networks for site work

190 While few question the desirability of producing an initial network, however broad-scale, to ascertain that a required completion date, and often intermediate dates, can be met, and to establish the interrelationships of large activities or groups of activities, there exist in the industry differences of view as to the extent to which:

(a) detailed networks should be prepared to assist in the execution of week by week or perhaps day by day tasks on site;

(b) networks should be updated throughout the life of the project to incorporate, or to examine the implications of, changes of timing, sequence or design.

191 A client engaged in a relatively small project might adopt a pragmatic attitude towards detailed networks: their use would depend on the preferences of the engineer in charge and on the nature of the job. Some jobs are almost purely 'sequential', ie there is not much choice as to the order in which the elements could be undertaken. Some jobs are repetitive, with similarities to a manufacturing process, where the use of multi-activity charts would be appropriate. Some jobs are sufficiently simple to be organised without resort to formal or 'paper' planning. Again, in some areas, the need for formal plans or networks is held to be questionable since 'interface' situations, ie those where the work of more than one contractor has to be co-ordinated, were rare or did not arise.

192 We would not question the validity, in appropriate circumstances, of these propositions. However, the management of one site whose policy is to procure its own materials and let 'erect only' contracts resist the use of detailed networks because they regard them as 'a two-edged sword'. Thus if materials for which the client was responsible did not arrive at the times indicated by a detailed network, his position vis-à-vis his site contractors would be weak. We believe, however, that clients should look upon detailed planning, preferably in network form, as a means for imposing a discipline upon their own operations.

193 Again, it is sometimes objected that a job is so complex or so frequently subject to change that networking and/or repeated updating would be too slow or too laborious. This view is challenged by management on other sites whose performance makes perfectly clear that networking can be successfully undertaken in situations of great complexity and fluidity; and who, moreover, claim that their problems would be unmanageable without it. Thus on a power station where a hundred or so contractors were employed detailed planning with updating of frequent, computer print-outs and the maintenance of visual networks were acclaimed by both client and many contractors as a substantial improvement on previous sites where less formal methods had been employed. Evidence was forthcoming: for example, it became clear from an updating of the network that a 'key-event' in construction, 'acid clean of boilers', to which firms were contractually committed, would be five months late. With seven months to go before the due date, the site work of a number of contractors was reorganised following a resource allocation routine, revised priorities were set for deliveries, and testing schedules were shortened or allowed to overlap: the due date was met. It may be noted that only three of the client's staff were exclusively devoted to planning (though receiving support from contractors' planners).

194 For such success in planning to be achieved certain conditions must be fulfilled:

(a) the top management of clients and contractors must have a knowledge of the techniques used and be committed to their use in appropriate situations;

(b) there must be a good system for the communication of accurate and up to date information between clients, contractors and subcontractors;

(c) there must be ready and speedy access to computer processing facilities—if networks are to be used for detailed work on large contracts the existence of these facilities can make the difference between success and failure (on one site, a fortnight elapsed between the despatch of information to a remote computer and the receipt of print-outs—far too slow);

(d) there must be adequate (but not necessarily numerous) trained, specialist, planning staff in the offices of clients and contractors.

195 We believe that the use of critical path analysis could, with advantage, be extended; but knowledge and experience spread slowly of their own accord, and we recommend the extension and greater use of courses in planning techniques such as have been pioneered by the Water-Tube Boilermakers' Association. We note with approval that some clients require evidence of competence in planning in the contractors to whom they award important contracts.

Contractors' overall planning

196 We refer now to a shortcoming sufficiently prevalent to warrant particular attention. This results from the existence in many contractors' organisations of separate, often highly autonomous, design, manufacturing and construction divisions. With few exceptions these divisions have their own separate planning sections. Often one section is dominant—usually the one, whether manufacturing or erection, where greatest expenditure is involved. At worst, the rule is, 'we (the site personnel) say when we want the material, the works just comply', or, elsewhere, the erection period is merely the time remaining between factory delivery dates (predetermined sometimes on the basis of getting high value components out first) and clients' completion dates. At best, the agreed plan is a compromise. It is not certain, however, that such a compromise will be optimal either in terms of overall cost or (as is often required) in total time for completion. Even if critical path networks are used, the most judicious distribution of float is not necessarily secured.

197 One company has recently abandoned separate divisional control of design engineering, procurement and construction, because they found the 'competing' attitude prevailing to be undesirable. Another has a single planning section covering these activities. Nor does it seem necessary for a central planning organisation to be 'authoritarian' at the planning stage, ie telling the engineers what they must achieve; for this would be to break the cardinal rule of planning—that those who will execute the plan must at the very least assent to it, but, far more desirable, should be actively involved in its preparation. In the firm referred to, central planning is regarded as a service department whose initial task at the beginning of a project is to produce a 'cock-shy' network which is then worked on by various departments until, by a process of iteration, a 'best' solution is established. The company acknowledged that this 'best' solution will not necessarily be truly optimal—for this would require resource allocation procedures, which have not yet been introduced.

198 Further benefits of central planning will accrue *during* the construction stage. A surprisingly large number of contractors' site managers whose views have been reported to us said they had little knowledge of the progress of manufacture (or procurement) of the materials they would require and, in some cases, were not informed of impending delays before delivery was due.

Those responsible for procurement, it is said, are tempted to conceal an incipient arrears position from the construction side in the hope that fate will intervene before the due date of delivery. Sometimes a site manager's only reliable source of information is the client's progressing staff. This state of affairs is highly unsatisfactory: delivery delays can be extremely disruptive of site work, but forewarning can allow site management to redeploy their labour and other resources to minimise disruption, and also at times, to express a preference, in an arrears situation, about what material deliveries should be given priority. In short, plans for site work seem often to be quite separate from, or only tenuously connected to, plans for design and manufacture. These three aspects of the project are clearly vitally interlinked, making essential integrated planning before construction but also integrated control once the project has commenced.

Planning for shiftworking

199 Though shiftworking is commonly used on sites to reduce delays that have occurred, there are very few projects where it has been envisaged from the outset and written into the network. Yet, as found in a study of the economics of shiftworking which we commissioned* there are larger potential savings to be derived from a decision at the planning stage to employ shifts on appropriate, critical activities, than when a project is already under construction.

200 The authors of the shiftworking report* estimate that setting increased labour costs against reduced interest charges, a net saving to the client of £10 million on a power station costing an initial £100 million would be theoretically possible given certain conditions. This does not include savings in generation resulting from the earlier use of the more efficient station; time saved in the planned construction phase might, however, be used to extend the design phase permitting firmer and more up to date specifications when construction does begin.

201 Benefits can also accrue to the contractors through accelerated cash flow or, possibly, through the more intensive use of plant.

202 We back the authors of the report in recommending that the economics of shiftwork in all amenable areas be carefully investigated, by inspection of networks, at the planning stage of all large projects.

Resource allocation

203 We are aware that there is little systematic resource allocation in use—that is to say, the scheduling of activities, taking account of their critical nature, to make the most economic use of available resources. Most computer programmes are purely time-based, and not designed to optimise labour utilisation. We feel that techniques themselves may be insufficiently developed here. It is true that many contracts are small and the scope for switching gangs from area to area to secure better utilisation is limited, and, within such limitation, can be achieved, by inspection of simple charts. Larger, more comprehensive contracts would increase the flexibility of manpower and hence increase, with the assistance of computer programmes, the possibilities of its more efficient use. We recommend such a development.

Communicating information

204 One senior engineer drew a distinction between techniques for getting the *logic* of a situation right—networks being the most powerful—and techniques whose purpose is *communication*—bar charts and simple ladder diagrams having a useful function here. In general, this seems to be well understood on site. However, the medium which appears most frequently in an *inappropriate* form for giving information is the computer print-out. Many print-outs on site appear never to have been used and were admitted either to contain

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*Summarised in Appendix 6.

unnecessary information or information in an inconvenient form. Nothing is more liable to foster an attitude of derision towards advanced planning techniques than the receipt of a print-out containing yards of (to the recipient) incomprehensible symbols.

205 It would seem essential to provide contractors with information in terms that they can understand, even if this means making different arrangements for the various contractors on the same site. There is support for the idea that on very large sites, an 'area' or 'managing' contractor should serve some of his subcontractors' agents with the same style of information that he would provide for his foreman (whom in background and abilities, they may closely resemble).

206 Having rejected the computer as a ubiquitous dispenser of information, we must uphold its place in the information systems of projects. In workshops and on site there is an abundance of ability to design, manufacture and erect, but, in the words of an engineer, 'management does not possess one tithe of the information necessary to gear these skills together'. In such a situation complete reliance on the 'manhandling' of information does not make sense. But the computer is not merely capable of handling the volume of information which a large project demands, its systems permit the passage of appropriate key information to all levels of management without the possibility of its suppression by those who might prefer to bury their mistakes: it enables better assessment of performance.

207 Although our concern in this section is with 'paper' communications, we are conscious of the great importance of good informal communications. Indeed, site personnel often speak of 'good sites' and 'bad sites' in terms of the quality of the relationships between clients' and contractors' managements: the trust and co-operation that exist will depend upon the calibre and acceptability of the clients' or prime contractors' managers—but also upon the prevailing contractual relationships.

A guide

208 We end this chapter with the suggestion that it is worthwhile to spend up to $\frac{1}{2}$ per cent of the total installed cost of a project on planning or programming resources.

Chapter 4 Industrial relations problems

Pay and conditions: the present position

209 We have referred to the way projects have grown in size and complexity during the last 20 years. They not only extend over years but may at peak periods employ 2–3,000 men. The magnitude of the work increases the possibility of industrial relations difficulties. In addition because such large projects have an obvious national and commercial importance there is a sense of urgency about their early completion. Accordingly, large sites are particularly prone to heavy and unremitting pressure from labour, whilst management is predisposed to deal with demands without regard to the impact of its decisions on the wider environment or upon the future. Each site is seen as a unique and once-for-all job and the overwhelming need is for its completion. In reality, what happens on that particular site has an impact on the others.

210 Large sites bring together a variety of workers of diverse skills from different and competing unions. There are both permanent and casual workers, 'travelling' men and locally recruited men. All are employed by many independent contractors who, unless controlled, act on labour matters in an unconcerted and sometimes in a competing way. Some sites are located in remote, often uncongenial, areas. Hostels and amenities are sometimes poor. Something like two-thirds of the work is on a casual basis, with all the disadvantages of casual labour—constant pressure for the highest possible earnings, a high turnover during the start up of a job and often low morale and disintegration of the workforce frequently at its most extreme as the job nears completion. Supervisors, who themselves may be casual workers, do not get to know their men.

211 Several national agreements apply to site work, negotiated in some cases without reference to each other* (although the Engineering Employers' Federation has, in recent years, attempted to introduce uniformity into those agreements to which it is a signatory). With the exception of those negotiated in the electrical contracting industry, the rates of pay agreed in national negotiations are not decisive in determining earnings, but are merely the starting point for a tangled structure of further payments, the result of constant and informal bargaining at site level—notably over incentive bonus schemes. This bargaining is conducted mainly by shop stewards rather than by local union officers with individual employers. The anomalies which result are often grossly inequitable and an inevitable cause of friction. Thus our research into earnings and hours of work covering over 40 large sites (set out in detail in Appendix 2) shows the existence of great disparities of earnings not only between sites but within the same site. Thus on a typical power station site the average earnings (excluding allowances) of the erectors/riggers employed by six different contractors in the same week were:

£31·2 £32·0 £32·6 £42·0 £50·4 £53·3

Similarly, welders employed by a different set of five contractors on an oil/chemical site received average earnings (excluding allowances) in one week of:

£29·2 £30·0 £31·0 £32·5 £48·7

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*The different conditions in various agreements are summarised in Appendix 4.

In another example, the pipefitters in one company working on average slightly less overtime than pipefitters in two other companies were nevertheless earning (excluding allowances) some £10 a week more. Earnings for the same skills *between* sites may often vary even more. On some sites the bonus element in earnings may be as much as 100 per cent, on others, nil. The amount of overtime varies similarly—on certain sites men have been working 35 hours overtime, which allowing for meal times calls for attendance at the site of about 80 hours per week.

212 In addition there have developed on oil and chemical sites individual 'site agreements' the purpose of which is to produce more uniform and firmly applied systems of pay and conditions for the sites to which they relate. These agreements, covering all mechanical and electrical work, can be an important step towards the achievement of a more stable situation, though sites where such agreements have operated have not been free from labour trouble, and the increase in hourly rates negotiated in successive site agreements has worried both clients and employers.

213 Thus at present two distinct systems of pay and conditions coexist arising from two different negotiating systems each with its own philosophy. Broadly, site agreements operate in the oil and chemicals (private) sector, while national agreements with heavy bonusing operate in the public sector, eg power station and steel plants. The differences arising from these two approaches are illustrated in Tables 4 and 5. It will be seen that total earnings are higher on power

Table 4 Composition of average weekly earnings by selected skill groups
CEGB *conventional power station sites*

	Basic pay		Overtime		Bonus pay		Allowances*		Other		Total weekly earnings	
	£	%	£	%	£	%	£	%	£	%	£	%
Pipefitters	18·0	48	5·7	15	7·1	19	5·1	14	1·6	4	37·6	100
Welders	18·1	39	6·4	14	11·8	25	4·9	10	5·5	12	46·7	100
Erectors/ riggers	17·3	42	5·5	13	11·6	28	4·4	11	2·6	6	41·3	100
Semi-skilled	15·7	48	6·9	21	5·5	17	3·7	11	1·1	3	33·0	100
Unskilled	15·2	54	3·5	12	4·5	16	2·6	9	2·3	8	28·2	100

*Radius, lodging and travelling (taxable) allowances.

Source: NEDO survey.

Table 5 Composition of average weekly earnings by selected skill groups
Oil and chemical plants

	Basic pay		Overtime		Bonus pay		Allowances*		Other		Total weekly earnings	
	£	%	£	%	£	%	£	%	£	%	£	%
Pipefitters	22·0	60	6·1	17	2·8	8	2·6	7	3·1	8	36·6	100
Welders	23·9	57	7·7	18	4·8	11	3·1	7	2·5	6	41·9	100
Erectors/ riggers	21·3	58	6·1	17	4·6	12	2·6	7	2·4	6	36·9	100
Semi-skilled	16·5	56	6·3	21	2·8	9	1·9	6	2·1	7	29·6	100
Unskilled	15·1	59	4·8	19	2·6	10	2·0	8	1·2	5	25·7	100

*Radius, lodging and travelling (taxable) allowances.

Source: NEDO survey.

station sites than oil and chemical, although basic pay is significantly lower, and this is mainly due to higher bonus payments and allowances.

214 The earnings of electricians (Table 6) are subject to the variations which affect other trades, but in addition they will be conditioned by the type of employer for whom they are working. This is because electrical contractors are subject to Joint Industry Board* rules regarding bonus schemes on national agreement sites (but not on all site agreement sites), whereas boilermaking firms employing electricians are not so controlled.

Table 6 Composition of average weekly earnings of electricians by type of contractor

	Basic pay		Overtime		Bonus pay		Allowances*		Other		Total weekly earnings	
	£	%	£	%	£	%	£	%	£	%	£	%
Constructional steelwork and general eng.	20·0	57	4·9	14	6·2	18	1·5	4	2·5	7	35·0	100
Electrical eng.	17·6	45	11·2	29	4·8	12	4·9	12	0·6	2	39·1	100
Instrumentation eng.	20·4	58	9·2	26	0·2	1	4·9	14	0·2	1	35·0	100
Boilermakers	21·3	43	8·4	17	11·0	22	6·3	13	3·0	6	50·0	100
Tank erection, pipes and pipework contractors	22·4	64	0·8	2	4·2	12	6·9	20	0·5	1	34·8	100

*Radius, lodging and travelling (taxable) allowances.

Source: NEDO survey.

Notes on Tables 4, 5 and 6
The size of bonuses appearing in the tables may be misleading since the earnings of bonus-earners and non-bonus earners have been averaged.

215 The disparities in earnings illustrated in these tables are paralleled by lack of uniformity in arrangements and allowances for travelling and subsistence. For example paid weekend travel home for siteworkers in camp or lodgings is granted fortnightly under one agreement and every eight weeks under another; nightly lodging allowances range from twenty to thirty shillings.

216 Wide and irrational discrepancies in pay contribute to excessive labour turnover and to a general impression of irresponsibility. We are agreed that the present pay situation is chaotic and that well planned attempts at order on some sites are being undermined by absence of control on others. Much of this chapter is concerned with seeking the means to a method of payment which reflects the particular needs of the site industry as a whole but at the same time provides sufficient flexibility to allow for special conditions on particular sites. In our view the existing differences between the arrangements applying on power stations on the one hand and oil refineries and chemical plants on the other have no basis in industrial logic and in the search for a solution our approach has therefore been in terms of a large sites industry.

217 In an irrational environment of this kind, labour trouble is inevitable and the industry has in fact a strike record which gives cause for concern:

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*see § 234 & 235 and footnote.

in 1968, 911 days were lost per 1,000 workers.* A special study for the Working Party by the Department of Employment and Productivity groups the causes of dispute as shown in Table 7.

Table 7 Causes of stoppages of work on large industrial construction sites Jan 1964 to Dec 1968

	% of total
Wages	
Bonus	24
Other*	17
Dismissal	19
Site conditions	8
Working practices	7
Sympathy	7
Demarcation	5
Redundancy	3
Other	10

*Including disputes over curtailment of overtime.

Source: DEP (additional data in Appendix 4).

From Table 7 it will be seen that disputes over pay, and in particular over bonuses, predominate.

218 This strike record, though indicating a worrying loss of production, tells only part of the story. It does not show the extent of 'go slows', refusals to work overtime, or the debilitating hostilities between management and men. The poor labour productivity and the apathy found on most sites represent a more serious problem than disputes. From our experience and from the activity sampling we have commissioned on three sites† we have evidence that men are actively at work for about half of their working day—nor does this mean that they are necessarily working effectively in this time. This poor output is the essential problem. We see the achievement of improved industrial relations therefore not as an end in itself but as facilitating higher productivity, which will also be assisted by changes in the managerial policies outlined elsewhere in this report.

National and site agreements

219 The situation revealed by these statistics leads us to believe that an orderly system for the sites industry with its transitory work places cannot be obtained except on a national basis, recognition being given to local negotiation of certain defined matters. With one dissentient we consider the arguments for an effective national agreement covering a wide range of work and containing uniform rates of pay are compelling:

(a) it would give concrete recognition to an industry identity which we consider highly desirable;

(b) it would help to provide greater consistency of wage rates, earnings, conditions and benefits, and hence reduce the chain reaction of claims and disputes based on comparisons with other sites and between different employers on the same site;

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*Compared with 150 in construction generally. Only motor vehicles (1,800), shipbuilding (1,800) and road passenger transport (1,000) had a worse record in 1968.

†Undertaken by reasearch workers in conjunction with the University of Manchester Institute of Science and Technology.

(c) the siteworker would operate under the same agreement regardless of changes in location and employer, hence mitigating the undesirable effects of the 'learning period', as each new contractor on a site and his labour force accommodate, often after disputes, one another's requirements and expectations;

(d) orderly movement between sites would be encouraged, and it would be possible to introduce industry-wide benefits which would reduce the present casual nature of employment;

(e) the authority of the official leadership of the unions would be strengthened;

(f) it would permit contractors' estimates to be made with greater accuracy, so reducing the uncertainty over construction costs which undermines present client-contractor relationships;

(g) finally, it could involve those contractors and subcontractors who are not now negotiating parties to site agreements, and hence eliminate the imposition upon them of terms inconsistent with their national arrangements.

220 We cannot foresee the adoption in the immediate future of a uniform consolidated rate of pay on all sites but we consider that agreement nationally to provide uniformity in a number of matters is both essential and practicable in the short term. Such matters include travelling and lodging allowances, holidays, hours of work and the rules governing termination of employment, and could be extended to include overtime and shift premiums and condition payments, where appropriate.

221 Uniformity of pay would, in the first place, be eroded by incentive payment schemes (but see § 228–233), under which total earnings are fixed by constant bargaining over targets, etc at site level. Secondly, there is at present a differential between earnings that work on large sites commands and those on small sites. This could not be removed immediately. Nor could separate rates for large and for small sites be negotiated nationally: there would be an insurmountable problem of defining large sites for this purpose, while the unions would not recognise the two classes of worker that two rates for similar work would imply. Negotiation at site level will continue and any attempt at improvement must recognise this fact.

222 Site negotiation has certain positive advantages. Negotiation leading to specific agreement before work on site starts can anticipate and resolve questions of demarcation and allow productivity matters to be discussed. It can also provide an opportunity for the control of overtime. Our research shows that under some current site agreements there has been a successful effort to control overtime (see Appendix 2, Table A.39). The high consolidated rates contained in site agreements have made overtime premiums expensive. An excessive amount of overtime is a feature of most sites where national agreements with a low rate form the basis of pay, eg power stations. We believe consistent overtime is not worked to complete programmes on time but arises from the necessity to provide acceptable earnings when the basic rate is 'out of line', and that the pay system should discourage rather than encourage regular overtime working. Local settlement would also deal with the amount of shiftwork and with such matters as the detailed facilities for shop stewards, the procedures for dealing with redundancy, and, if a bonus scheme were operated, its targets and 'gearing'.

223 In view of the foregoing a case might be made for abandoning national agreements, some of which have fallen into disrepute, in favour of formal site

agreements alone. There are, however, objections to such a course. The relationship between local and national officers of the unions becomes uncertain. It is also questioned whether local union officials can commit workers yet to be recruited to a site, to conditions about which they have not been consulted unless they are supported by a powerful union executive.

224 It is also feared by some that an extension of site agreements would mean an escalation in labour costs as a result of a chain reaction of claims, and this process would be faster than if the situation were left in its present admittedly disordered state. (This has not, however, been supported by our research.)

225 Again, site agreements free of any outside restraints can allow the 'rogue' client with a single project to sacrifice the long term stability of the industry to his own immediate objectives. This is a potent danger in a situation in which timely completion appears paramount and capital costs (often attracting the maximum investment grant) are of lesser importance. In these circumstances, also, contractors may be led to neglect supervision and good communications in the belief that an inflated rate can buy immunity from concern over the quality of site management.

226 Finally, because sites are transitory (and completion is always urgent) it is undesirable that time should be wasted—and hostility engendered—while siteworkers and employers measure up on each site to one another's demands and accommodate themselves afresh to new conditions; it is better that terms and conditions are as far as possible previously accepted, universal and familiar. This view is not a denial of the idea of workshop bargaining which is currently in favour, but a recognition that the sites situation has important differences from the workshop—men and management do not get to know each other, there is no opportunity for customs and practices for settling conflicts to be evolved; finally, at the time that comprehensive negotiations should take place, ie before work starts, there is no workplace.

227 We judge that some bargaining at site level must continue in some form. The issue, however, is whether it should continue to be, as on some sites at present, informal and unremitting, or whether, as we believe, it should be made explicit, planned and undertaken as far as possible before work starts, and fall within the framework of a national agreement. Thus any debate on national versus site negotiation is unreal in the site context because both are required. In our view a national agreement should determine clearly the role of site bargaining, setting it clearly within the national context. We have proposals to this end, but before putting them forward it is necessary to consider the contentious issue of incentive payment schemes and the part they play in the bargaining process.

Incentive payment schemes

228 The large majority of us consider that present incentive payment schemes are not only generally ineffective in securing greater effort but, because they are not controlled, are a significant factor in wage inflation. These members contend that incentive schemes depend on a smooth flow of work which is not always attainable in mechanical and electrical erection, that present schemes are rarely based on work measurement, are manipulated by both management and workers, sometimes in collusion, to provide acceptable earnings and are a serious, and self inflicted, cause of industrial disputes.* They also point out that where they exist the real bargaining on earnings takes place in a constant confrontation between shop stewards and managers. This incessant bickering over targets is at the root of many labour disputes, and contributes to the anomalies and disorder we deplore. It also means that the shop stewards who

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*see Appendix 3, § A.158–A.163.

negotiate in this way achieve a power which is not provided for in the structure of some unions and for which they lack experience and training.

229 A minority of us, however, could not at present consider the abolition of bonus schemes, though some hope they will be replaced in the longer term. They believe it is necessary to attempt to link earnings with output when employing a largely casual labour force. The employment of uniform and consistent bonus schemes to be applied on a 'site' basis is seen to be essential. The possibility of forfeiture of the bonus element is also viewed as a protection against 'go-slow' and 'work to rule' tactics. High priority is therefore attached by those holding this view to any measures which will help 'decasualise' the industry, thus reducing the reliance on an admittedly unsatisfactory pay system.

230 All of us call for a critical reappraisal of existing schemes. This should lead to the abandonment of those which do not meet the stringent requirements of sound schemes.

231 We were anxious to see whether it was possible to establish common 'work norms' to be used throughout the industry not only for incentive bonus schemes but also for estimating, planning, and the control of work. Such a 'data bank' of standards, coupled with a common form of 'gearing' of schemes, would provide the basis for a uniform incentive payment scheme throughout the industry. We therefore commissioned a study* to see if it was possible to establish a bank of common standards. The conclusion was that a bank was both a theoretical and practical possibility, but that it depended on, and could only follow from, an expansion of work study in contracting firms, and this is likely to take considerable time because the industry is backward in its use of work study, having only one work study practitioner on site for every five hundred or so workers employed.† The study advocated the introduction and use of a data bank to help the estimating, planning and control functions, and reported that the bank could be used for incentive payment schemes but found many impediments to the effective use of incentive payment schemes in plant erection work.

232 We have accepted that some major contractors supported by some clients will not abandon lightly the use of incentive payment schemes and in some instances may be unable to do so without serious disruption because a change in pay policy entails changes in the management structure and method of work. For the time being, therefore, the industry must continue to accommodate such schemes. The fact also remains, however, that while they exist they will, unless firmly controlled, set the pace in wage inflation, thus undermining any new national agreements. The 'realistic', and therefore, higher rate we advocate in § 235 would in the absence of control merely become a higher platform for uncontrolled bonus schemes. The Department of Employment and Productivity have expressed their concern to us over this possibility.

233 From the foregoing it will be seen that we are faced not only with the reform and improvement of bargaining methods, but also with the introduction of controls over incentive payment schemes.

Proposed comprehensive national agreement

234 We recommend** an effective overall national agreement covering all mechanical and electrical work on these sites (excluding the purely building and civil engineering work), which we consider would be a strong influence for uniformity and order. (We recognise however that as long as such an agreement accommodated incentive payment schemes it would be treated with some

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*Summarised in Appendix 7.

†see Appendix 2, § A.93–A.97.

**But for a dissenting view by one member, see § 245–247.

reserve by the Joint Industry Board for the Electrical Contracting Industry.*) This agreement would leave certain matters for settlement at site level as we explain later.

235 The key to an effective, comprehensive national agreement is a more 'realistic', and therefore, higher national rate. The present national rates which apply in mechanical erection work are inadequate and unrealistic, and, as shown in Table 4, the basic weekly pay provided by these agreements is less than half the total of weekly earnings. We further recommend that a 'high' consolidated rate, applicable without variation on all sites and precluding further incentive payments, should be the goal of the industry (a goal, we note, already achieved under the JIB for Electrical Contracting), but, with the exception of one of us†, we accept that opinion is such that this is not obtainable throughout the sites in the short term.

236 The more realistic the terms and pay in the proposed national agreement for all plant erection work the less need and scope there would be for local bargaining on earnings.

237 We show in Table 8 what matters national negotiations could remit to site level. Essentially the division is between those matters where uniformity is desirable, calling for national settlement and those matters where there is an element of variation between sites, calling for local negotiation.

Table 8 The national agreement—matters for determination:

At national level	*At site level*
Basic rates and differential pattern for skills	Bonus schemes
Hours of work	Productivity payments
Premiums for overtime and shiftwork	The removal of demarcation practices
Holidays and holiday payment	Redundancy
Travelling and subsistence	Special payments of allowances for unique site conditions
Recognition and facilities for stewards	Detailed steward or union facilities
Settlement of grievances affecting 'national' policies	Domestic grievance procedure
Code of amenities	Control of overtime and the use of shiftwork
Code of dismissals, safety, etc	

238 Such an arrangement would recognise the industry identity providing an important stimulus to coherence, but at the same time provide the flexibility necessary to encompass varying conditions.

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*There are a number of references in this chapter to the Joint Industry Board for the Electrical Contracting Industry. This is a joint union/employer organisation with its own staff, providing a joint control of employment in the industry for the following purposes:
(a) improving and expanding education and training;
(b) improving skills and efficiency by the grading of operatives;
(c) increasing productivity by improved methods of work;
(d) improving the welfare of employees;
(e) increasing the profitability of the industry;
(f) measuring output to ascertain productivity and evaluating its source;
(g) regulating employment, controlling overtime and eliminating all unauthorised stoppages of work; and
(h) providing for a right of appeal by either employers or employees from decisions of the board to an independent authority, who could be either a specified person or office or an agreed arbitrator.
There is evidence that the JIB agreement has contributed to the improvement in industrial relations in electrical contracting. Thus, for example, days lost through strike action continue to show a decline which began in the early 1960s.

†see also § 240.

239 We therefore see the pay structure of the industry in the immediate future as being made up of:

(a) a national time rate, and

(b) either (i) incentive payment earnings derived from a bonus scheme agreed formally at site level;

or (ii) where incentive payment schemes do not apply a 'productivity allowance' agreed at site level containing specific provisions for the more effective use of labour.

Provision should be made under either arrangement for the control of unnecessary overtime.

240 One member, dissenting from the view expressed in § 235 & 239, is of the opinion that the promotion of a national agreement with a high consolidated rate is feasible in present circumstances: employers and unions should be encouraged to see this as an immediate aim and to use whatever opportunities may be afforded to bring it about.

241 If incentive payment schemes are to continue it is essential that the industry finds ways of controlling them. We are not opposed to high earnings under such schemes, indeed we welcome them providing they are related to higher output. The negotiating processes we have described can help this control. The national agreement could lay down guidelines for bonus schemes, eg on the method of 'gearing', the system of work measurement, and the total earnings to be expected for 'standard performance'.* Details determined at site should contain the terms of the bonus scheme and descriptions and times of work standards. The explicit formulation of such schemes for the purposes of negotiation in itself makes for a rational scheme. This discipline would make for the demise of shoddy schemes. It will also be seen that the negotiation and inclusion of one incentive payment scheme in a site level bargain would bring about uniformity. The anomalies and disputes arising from the use of different schemes by different contractors for the same work would be largely eliminated.

242 Clients should in their own interest assist this control. Some clients realise that they must take an active interest in the pay practices of their contractors. One for example prohibits the use of incentive schemes for most of the work, while another introduces a common scheme with common work standards. It is for each client to decide on his own strategy but it is strongly urged that for large sites he should have a definite policy and either forbid or require incentive payment schemes for particular work. If he accepts incentive payment schemes he should exercise some control by ensuring the scheme is contained in the site-level bargain and enforce its terms. He should also audit the earnings provided and insist on his major contractors possessing a work study capability in the same way as many clients seek to satisfy themselves that their contractors use modern planning techniques, eg network analysis.

243 We do not consider that these measures would avoid all disputes associated with bonus schemes. Nevertheless if persevered with they would introduce greater control and avoid some of the present irrationalities which lie at the root of labour unrest.

244 If, however, a common pattern of and control over site negotiation is to be achieved it seems important that, as well as the leading contractors and local union officials, national officials should be associated with it. This means the national agreement must contain constitutional provisions for site negotiation.

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*In work study terms, a rating of 133 on the 100/133 scale.

A dissenting view

245 A member from an oil company is opposed to the concept of a national agreement. Whilst agreeing with the diagnosis of the industry's problem and recognising the need for something of a career structure for the industry, so that the casual nature of employment can be minimised and the efficiency of the workforce improved, he feels that the introduction of benefits based on continuity of employment (eg pensions, sickness benefit, training schemes, etc) would be more effective than centrally bargained terms for lodging, travel and other fringe benefits, which may or may not be appropriate to the local area.

246 This member also feels that the introduction of a national agreement will do nothing to control the current problem of undue wage escalation, particularly when it is only part of a two-tiered structure with the second tier being either an incentive or a 'productivity' payment to be agreed at site level. He points out that nationally agreed base rates which have a superstructure of local payments on top of them, traditionally have become unrealistic and meaningless. He also believes that to form national agreements when there is a move both in government and industry towards locally based agreements, would be a retrogressive step. He believes that national agreements and procedures can be cumbersome and time-wasting whereas bargaining associated with local needs and conditions encourages flexibility of action and greater commitment.

247 Nevertheless he accepts that some form of control is necessary in order to restrain wage escalation and, in particular, to deter any employer who is prepared to sacrifice national, long term considerations to the pressures of short term expediency. He believes, however, that the necessary degree of control could be exercised by the relevant employers' association, strengthened by client support, if each individual employer was required to convince the association that the settlement he intended to make at a negotiation was reasonable and non-inflationary, bearing in mind both the circumstances of the particular site and the going rates and conditions elsewhere. In this way, local agreements would emerge which would recognise the differences between different sites but at the same time inflationary and unjustifiable differences in pay and conditions between them would be eliminated.

A national joint council

248 What implications would a national agreement as proposed have for bodies in the industry? We consider that such an agreement would be impossible unless it were preceded by a coming together in some form for the purposes of joint negotiation of the various employers' associations in the industry (the Engineering Employers' Federation, the Oil and Chemical Plant Constructors' Association, the Heating and Ventilating Contractors' Association and the Thermal Insulation Contractors' Association). We hope that the Electrical Contractors' Association would find some way of co-operating with such a grouping; it is not in their interest to stand aloof and they can best protect their ambitious plans for their industry by active participation. In any case there are other matters besides the contentious issue of bonus schemes which are of common interest to all employers.

249 Equally from the workers' side there is a need for the unions to develop some arrangement for presenting a common policy as have been developed when currently negotiating site agreements. We are of the opinion, therefore, that a national joint negotiating council would be of advantage to the industry and we hope that such a body will be developed in due course. Its creation would, we hope, have the active support of the Department of Employment and Productivity, the TUC, and also of the clients' council we suggest later (§ 254). Until then, the 'coming together' that we seek should be accomplished by means of the steering committee which we describe in Chapter 5.

250 The member whose dissenting note appears in § 245–247 has further reservations as to whether the industry is sufficiently homogeneous as to make a

single council desirable and effective. He sees the industry as divided into two distinct segments, one concerned with oil and chemical plant erection, and the other largely with power stations. He contends that work in these two segments is different, that the clients fall into two classes—private and public sectors—and that the contractors are more or less divided between the Oil and Chemical Plant Constructors' Association and Engineering Employers' Federation.

251 The remainder, however, would be seriously disturbed if the target of a single national agreement were not adopted. Oil and chemical plant and power stations alike compete for the same skills, in the same unions, have the same training needs, have the same problems of site management and have the same working environments. There are contractors who operate on all types of site, and diversification of activity is likely to increase particularly in a period when power station building is reduced. If two *identical* agreements emerged, there would be no point keeping them distinct: if *different* they could foster the disorder both sides wish to avoid. Such a division would also obscure the larger industry identity we are anxious to encourage.

The client's role

252 We have referred in § 242 to the need for an extension of client concern with the operation of incentive systems. Equally we consider the support by the client to be an essential condition of any national agreement including that part formally negotiated at site. It is axiomatic that he should require observance of the terms of the agreement as a condition of contract.

253 All attempts at order would founder if a contractor supported or instructed by his client attempted to 'buy his way out of trouble' when faced with a militant workforce and the collapse of his management controls. The heavy cost of delays in commissioning large projects provides such a temptation, however self-defeating such a policy might prove. Accordingly we consider it essential that clients should themselves set up machinery for imposing a discipline on themselves and thus on their contractors.

254 We refer in § 248 to the need for a new alignment of employers. Such a body could bring some pressure to bear on breakaway contractors, but it would lack power unless it were supported by an association of the major clients whose spending programmes provide the large part of the contractors' future livelihoods. Such a body might also impose some moral restraint on irresponsible clients. And it could also possibly provide for the exchange of information on future projects and some co-ordination of their timing. We therefore recommend the setting up of a council of the major clients for these purposes.

255 In our view the client should no longer stand aloof from the way the site is managed. He is not purchasing a ready-made article but committing large sums of money over a long period. The efficiency of the ongoing work and the way it is influenced by the quality of the industrial relations on site are crucial to him. He has a latent authority and we believe that in his own interest he must use it to provide the needed uniformity of policy among diverse and competing contractors. The extent and manner of his intervention will depend on the circumstances of each project and will of course be influenced by the form of contract he favours and whether or not he is managing the site himself or using a managing contractor.

256 It is suggested that the client (and/or turnkey contractor) will need to concern himself with:

(a) compliance with the national agreement;

(b) initiation within the terms of this agreement of site-level bargaining and the subsequent monitoring of the terms agreed;

(c) if incentive payment schemes are in operation, their nature and control;

(d) the provision of amenities;

(e) when choosing a contractor, the competence of that contractor in industrial relations and safety;

(f) the support of employers' associations and of trade unions;

(g) encouraging contractors on site to meet together on labour matters;

(h) monitoring the safety discipline and precautions of his contractors, and fostering awareness of safety measures, eg by setting up site-wide committees of all contractors and of workers' representatives on site.*

257 This is a radical departure from the traditional role of some clients, and some may need to build up the specialist personnel resources needed. Some clients may find this intervention unpalatable but we believe several factors make it inevitable. In Chapter 1 we pointed out that the size, complexity and the time span of projects often make lump sum contracts inappropriate, and suggested that some form of reimbursable contract fitted construction needs better. Such contracts require close monitoring of labour costs by the client and thus of the pay and personnel policies of his contractors.

258 The growing size and advanced design of projects makes the task of integrating the work of different contractors increasingly difficult. The site as a whole has to be managed by the client. But 'management' does not stop short of industrial relations problems and policies.

259 Lastly, the climate of industrial relations on sites has been deteriorating. The response of some contractors has been to seek a greater unity of purpose and more appropriate and up to date personnel policies, but elsewhere the reaction has been to bid more and more money while accepting poor output. Clients must face up to this threat to their interests.

Four matters for negotiators

260 We have set out in § 228–233 our views on methods of payment and in Table 8 those matters for inclusion in the national agreement. We now discuss four of these topics to which we attach particular importance, namely, travelling and lodging arrangements, demarcation, the role of shop stewards, and grievance procedures.

Travelling and lodging arrangements

261 The negotiators of the new national agreement we have proposed would have to face up to the difficult problem of travelling and subsistence allowances. There is an obvious need for reform and uniformity. We show in Appendix 4 the intricate and different provisions for travelling and subsistence allowances in the various national agreements. We hope these agreements will be superseded by comprehensive provisions in the proposed national agreement; this will call for certain levelling up.

262 Site work involves disadvantages not present in most other jobs, and to make it attractive calls either for special remuneration or for mitigation as far as possible of these disadvantages. The former may be necessary anyway, but mitigation wherever possible seems preferable: it avoids disruptive and possibly inflationary comparisons with other workers in the locality, while the dangerous doctrine that men will put up with anything as long as they are paid enough is given no chance to flourish.

263 To those negotiating travel and subsistence allowances for the large site industry we suggest:

(a) that most men, if the opportunity permits, would prefer to live at home. If they elect to do so and this involves considerable daily travelling they should

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*For a recent discussion of safety matters, see *Safety on Construction Sites*, Institution of Civil Engineers, 1969.

be fully compensated. Where suitable public transport is not available buses must be provided;

(b) that lodging allowances necessary to attract and retain permanent travelling employees who travel from site to site and the facilities for their journeys back home at the weekends should be sufficiently generous and explicit. Sometimes these men are compensated for working in distant and inhospitable locations by undercover adjustments to agreed rates. Sufficient allowances would help make for a larger proportion of permanent 'travelling' men, thus assisting efforts to decasualise the industry (see § 282–291).

(c) that it is better that certain payments, at present the subject of 'sympathetic consideration' by the employer, eg retainers, payment for lodgings during sickness, etc, should be covered by formal agreement.

Demarcation

264 Demarcation is not a serious cause of disputes—except in a few and usually well-published cases. We believe however that the industry has accepted demarcation restraints rather than challenging them. The adaptation of the work that has occurred to these impediments rather than the resolution of the occasional dispute that arises on their account is the real problem. We were encouraged by the frank discussion we have had on what can be an emotional issue. We are agreed:

(a) that the removal of demarcation practices is not as pressing a problem as improving the general pace of working. Their removal does not automatically make for more effective work; managements must use the opportunity so presented to organise the work differently and more effectively;

(b) that demarcation practices arise from the desire of workers to protect their jobs and status particularly during periods of unemployment. Greater security of employment would greatly help their removal;

(c) that complete flexibility of work is neither possible nor desirable. The core of each trade should consist of some special and unique skills. It is on the boundaries of jobs that some overlapping of work is necessary;

(d) that a more sensible job structure can arise from the mergers of competing unions whose separate existence can lead to disputes over 'who does what'.

265 The reform of trade unions structure will not come overnight and can be achieved only by the unions themselves. We think, however, that clients and contractors in the industry are entitled to voice their concern if progress is slow.

266 Patient and persistent negotiations on flexibility arrangements at local level are also needed, and this is one reason for formalising site bargaining. We have, however, been warned by experienced trade unionists that there is a danger in such negotiation of the unions committing themselves to the removal of traditional and cherished 'protective' practices which cannot later be enforced. The unions are not policemen for this purpose. Such reverses should be avoided because they bring negotiation into disrepute. Progress may need to be slow and unspectacular. The solution to demarcation problems is unlikely to be found in an approach to them in isolation. It is more likely to come from a complex of factors notably those which would help in the removal of the uncertainty of employment.

267 We recommend that the disputes procedures in the proposed national agreement contain specific provision for the resolution of demarcation difficulties that do occur.

The role of shop stewards

268 Good industrial relations consists of the exposure of conflicts and a search for and acceptance of settlements. This will not be achieved unless there

is an ungrudging acceptance of the difficult and exacting role of shop stewards. There is a high turnover of site stewards and difficulty in getting experienced and competent men to carry out this work. We have considered what action can be taken by contractors and trade unions to solve this problem. We emphasise that the spirit with which an employer approaches his industrial relations problems is more important than constitutions or regulations. Clients should be aware of this and take account of the record and policies of contractors when inviting tenders. However, written procedures and provisions have their place. A national agreement should, therefore, cater for:

(a) the number and constituencies of shop stewards;

(b) their facilities;

(c) the access of permanent trade unions officials to the site and arrangements for their discussions with shop stewards;

(d) deductions of unions dues.

269 Negotiators should also face up to certain other questions:

(a) should a union shop steward of one employer be permitted to make representation on behalf of another member of his union who is in the employment of a different contractor?

(b) should site committees of stewards be recognised and facilities provided. If recognised what should be their role, eg should they be able to negotiate on a site-wide issue?

(c) should union membership be expected as a condition of employment?

270 The question of the election of shop stewards should not be overlooked. A union may need facilities on site for elections. The mode of election and the qualifications for office are understandably a sensitive issue for the unions, but we do not think the subject is so sancrosanct as to be beyond sensible negotiation. It seems, for example, that both employers and unions have a common interest in seeing that a steward should have had some experience of the industry. The ungrudging recognition of shop steward activities that we regard as essential will come more easily if employers know that the unions have formulated rules on the appointment of stewards and will apply them rigorously.

271 Both unions and employers have a joint interest in the training of stewards in their representative duties. We hope the unions will expand such training but employers can help by providing time off for this purpose.

Grievance procedures and the avoidance of disputes

272 Grievances and disputes are inevitable. The problem is how the industry can reduce them and how they can be resolved when they do occur.

273 We submit that the more there is an accepted system of pay, conditions and working rules and the more this system is communicated to and understood by the workers then the more the situation is likely to change from frequent conflicts about what is 'fair' to less frequent disputes about the interpretation and revision of agreed formulae. We believe, therefore, that the introduction of an improved national agreement will help establish the order that is needed. But more can be done. Whether employed on a casual basis or within some form of registration scheme men need to move from site to site. It is suggested, therefore, that the industry as a whole should seek to establish a common code of discipline particularly on dismissals. This would be a useful supplement to the negotiation on duties and facilities for shop stewards we have already suggested.

274 We put forward two suggestions to help employers and unions to find quick and lasting settlements to those disputes that must still occur. First,

nearly half of the present disputes are about pay, particularly about bonus earnings. There are no agreed criteria for resolving disputes over the equity of 'targets'. The national agreement should therefore cater for the method of work measurement to be used, but as an interim measure a possible means of settling disputes over 'norms' would be for the employers and unions each to appoint an officer versed in work study who would judge the fairness of a disputed work target by reference to other targets in the same incentive payment scheme.

275 Secondly, it is significant that there is notable success in finding solutions to disputes at the second stage of a procedure when the professional negotiators on both sides are brought in. The trouble is that often there is a stoppage before this stage is given a chance, and generally this happens because there is an unacceptable delay in convening the second stage. This may be the fault of both 'sides'. We hope the negotiators of the agreement we advocate, at national and site levels, will face up to this problem.

276 There is another difficulty about grievance procedures. An obstacle to a linking of the employers' associations for joint negotiation is concern over the mode of procedure that would prevail. For example the Engineering Employers' Federation would wish to continue to offer to its members the special expertise its regional officers have acquired in resolving disputes. On the other hand, the other employers' associations would be reluctant to ally themselves too closely with what is known as the 'Engineering Procedure'. Equally the unions are jealous of their prerogative of guarding the interests of their members according to their particular philosophy. We think this issue should be exposed and consider that it could be resolved by discussion between the parties.

Amenities

277 We now discuss amenities (changing rooms, washing and toilet facilities, canteens etc) because we believe them to be unsatisfactory on some sites and that this can contribute to labour unrest. (See Appendix 3, § A.164–A.166.) Because, in our view, the client has a predominant role to play in securing satisfactory standards, negotiation between employers and employees alone will be insufficient.

278 We believe that the problem consists of defining a reasonable and acceptable code of amenities and of fixing accountability for their provision. A site may employ many contractors. It is clearly impossible for each contractor to provide separate facilities but until recently there has seemed to be a tacit understanding that this problem should be ignored.

279 We suggest that the answer is that on any site employing more than one main contractor certain common facilities should be provided from one central source. The logic of the situation is that the client is best fitted to provide and maintain these common services, either directly or by entrusting the work to a single contractor appointed for the purpose. This would ensure a uniform level of amenities over the whole site and make it possible to provide a higher standard of services than could normally be expected from contractors working individually. There are also obvious advantages in the administration of these services.

280 Amenities should be of a good standard. We set out in Appendix 8 a code for use by clients in the future, which we recommend should be introduced on all sites. This code is a practical one and has used as its model sites with a reputation for good amenities. It was drawn up by a committee of experienced site managers and trade unionists aided by a chartered surveyor.

287 The cost of providing amenities on the lines set out in the code would of course vary according to the location and size of the site and the project's duration. However, a contractor with a high reputation for the standard of his amenities has provided cost figures, as an example, which relate to a site in

which an average of 1,000 men are employed over 100 weeks. These figures are given in Table 9.

Table 9 On-site amenities: specimen costs per man/week

	£	s	d
Medical		4	0
Shelters		4	6
Washrooms and lavatories		10	0
Catering—capital cost		5	0
running cost		5	0
possible subsidy for actual meals		3	0
Parking			3
	1	11	9

(protective clothing is assumed to be the responsibility of individual contractors and is not included above.)

This sum, for purpose of comparison, amounts to about 4 per cent of site craftsmen's typical total earnings and allowances of £38 per week.

The problem of casual labour

282 We have studied the extent of casual employment in the industry and its effects on efficiency and have concluded that the provision of more stable employment would be the most important single step that the industry could take to improve employer/employee relations and productivity.

283 What is the present situation? Table 10 shows the proportion of craftsmen regarded as permanent employees by different kinds of companies.

Table 10 Percentage of craftsmen regarded by contractors as permanent employees*

	%
All companies	37·1
of which:	
Oil and chemical plant contractors	18
Constructional steelwork	42·1
Electrical engineering	55·8
Instrumentation	31·5
Boiler erection	32·2
Tank erection	47·4
Heating and ventilating	57·9

Source: NEDO survey.

*Appendix 2, § A.67–A.80, contains more detailed information.

Table 11 indicates how much service craftsmen have had with their present companies.

Table 11 Duration of craftsmen's employment

Less than 6 months	6 months to 1 year	1 year to 5 years	Over 5 years
21·1%	27·1%	34·0%	17·8%

Source: NEDO survey.

As would be expected there are significant differences in employment stability according to type of employer. Employment is least stable among the major oil and chemical plant contractors; one-third of their total employees were estimated to have been with their companies for less than six months and only one-quarter for over a year.

284 Unemployment among siteworkers has been estimated from information supplied by the OCPCA relating to their members. This showed that among operatives sampled the average amount of unemployment experience in 1966 (the latest year for which a survey was made) was six weeks, having fallen from nine weeks in 1963. If the 1966 figure were valid today (and since the duration of unemployment in site work moves roughly in step with national unemployment the 1970 figure is probably higher) then it can be inferred that 12 per cent of siteworkers are out of work at any time.

285 As we point out below, greater permanence of employment demands willingness to travel. We know from our survey, however, that nearly 40 per cent of craftsmen employed on large sites can be classified as travellers, by virtue of the fact that they were living in local lodgings or camps.

286 Does casual labour matter? There is evidence that as the proportion of permanent men increases the amount of disputes decreases, and we feel strongly that a casual system can seriously impede efficiency. The relationship between managers and men and between work groups is transient. They cannot get to know each other and to learn to work together as they do in more stable employment. Supervisors are also frequently employed on a casual basis; this is particularly unfortunate because the quality and motivation of front-line supervision can make an important contribution to the smooth operation of sites.

287 Employers are unlikely to have the same sense of responsibility towards casual workers as to their permanent employees. It is difficult for an employer to introduce enlightened personnel policies in a casual labour situation. Despite their many disadvantages he may resort to incentive payment schemes because he can offer no other inducement to good performance.

288 Casual labour hampers adequate training of the workforce because it is not worthwhile for each employer to invest in the training of temporary men. Likewise, inculcation of safe working practices must start afresh at every site. Provisions for old age and sickness is not made and such benefits as salary status are not introduced. We attach much importance to the provision of these improvements in the longer term, for while casual labour persists on a major scale the gaps between the benefits offered by the plant construction industry and those offered elsewhere will increase. The industry will be restricted to recruiting those who will accept such standards and they may not be of the quality required. Alternatively employers will find themselves offering more and more money. Perhaps more serious is that the industry will remain dependent on other industries for its skilled men. At present it is essentially parasitic on others for its skill, and wastes those skills in a high rate of unemployment.

289 It is also suggested that casual employment promotes a casual response from employees. They do not identify themselves with the successful completion of projects and do not accept the conventions on punctuality, attendance, and

safety that apply in more settled work. With a workforce largely built up from scratch for each project, labour turnover in the opening period of a project is high and wasteful. In the completion phase workers have an incentive not to finish the job because completion is followed by unemployment. Inevitably during their spell on the project they seek the highest possible earnings because the job does not offer the security of a regular income.

290 In a casual situation employers concede to demands which they regard as unjustified in order to complete the job on time: what a contractor might regard as a worthwhile concession with casual employees takes on a different aspect in a situation of greater permanence, the long term impact of short term decisions becoming more apparent to the contractor.

291 Historically construction has been a casual industry. The particular project has been the be all and end all and the concept of a continuing body of work calling for an appropriate body of employees has not developed. While a casual workforce may have been appropriate for the building of the canal or railway systems the Working Party are agreed that it has no validity today.

Scope for decasualisation

292 As we show in Appendix 1 (see Table A.8 and Figure 3) there are at present (following an increase in activity) about 50,000 men engaged in mechanical and electrical construction. About 35,000 of these will be craftsmen. This is a relatively small number, and in view of the scale of the investment for which this small body of men is responsible we feel there should be made a major effort to devise means to put their employment on a regular basis. There are two possible approaches to the provision of more continuous employment:

(a) an increase by contractors in the size of their permanent workforce;

(b) the establishment of a register of workers committed to the industry.

293 We consider that conditions are appropriate for development under both these heads. The scope for the first depends on the continuity of the contractors' order books, while the register requires that total demand does not fall below a certain level. It is important that any sites register is established on an industry-wide basis. For as Appendix 1 shows, the fluctuating *total* investment conceals relatively greater fluctuations in individual sectors (see Table A.6), with high investment in one customer industry offsetting or partially offsetting troughs in another (eg 1972 is likely to see the lowest activity in power station construction, but is a peak year for oil refineries and steel plant). Fortunately, the similarity of skills found on a wide range of types of projects allows transfer of men from one to another, and thus an effort by the industry as a whole to move towards a more regular form of employment would make industrial sense.

294 Continuity of employment will, of course, require preparedness to travel. In this context we note that in a NEDO survey of siteworkers designed to establish their attitudes to various aspects of pay and conditions about 75 per cent of the sample declared themselves willing to travel anywhere (compared to the 38 per cent who actually 'travel' at present).

295 Against this background, how can the major contractors—and our researches show that it is they who have the smallest proportion of permanent employees—reduce their reliance on casual men? If the individual contractor is to build up a steady workforce he needs a steady work programme. We believe that there are too many contractors in most fields and a reduction in the number would help achieve greater continuity of work for those remaining. It is to be regretted that a recent attempt to merge by some boilermaker companies failed. Clients can help this process by their contract and purchasing policy.

296 We recommend that major clients with a continuing work programme offer repeat or successive contracts to help their contractors to plan their labour

force with increased confidence. In such a situation the client would be in a strong position to require his contractors to introduce effective personnel and training policies as well as introducing modern management techniques.

297 Some contractors have been disappointed because their offers of alternative work have been turned down by their employees at the end of a project, and have concluded that unemployment is 'voluntary', and encouraged by earnings-related unemployment benefit and redundancy payments. It is hoped that the major contractors will not take this attitude. We found that the extent of unemployment among siteworkers was much higher in those areas with high unemployment, indicating that it is influenced strongly by the availability of work and not by the action of the men.

298 It could also be that men have refused to be transferred because the initial selection of employees by the contractor was of temporary men rather than those seeking permanent employment and also prepared to travel. Major contractors need to select carefully their permanent men, in particular their supervisors, and to offer reasonable inducements to stay in their employ. These inducements, an assured income, pension scheme or rewards for long service, training and promotion opportunities, coupled with generous weekend travel arrangements are what carefully selected men will expect. To offer less benefits than those provided in indoor employment nearer to their homes would be ineffective.

299 The price of such benefits may appear high, and the employment of local casual men may appear immediately cheaper in money terms to the individual contractor. If present arrangements yielded a satisfactory output this view might be valid. But they do not, and it is our view that output from well-selected permanent men would be significantly higher than from casuals, less prone to interruption by disputes and accordingly would be obtained with lower unit costs.

300 While contractors should seek to increase the proportion of their permanent employees they will for the foreseeable future need to supplement these by further recruitment. An industry register of employment would, therefore, be useful, particularly for the larger contractors.

301 Any register at its inception would need to be voluntary. Men would refuse to be directed, and employers would not give up their 'right' of selection and dismissal. To survive, therefore, a register would need to offer advantages for both employers and workers. Employers would not use it unless it provided as good as or better workers than those they now recruit. The register, incorporating classification of skills, would need to have a reputation for quality. Equally workers would not accept registration and classification unless it paid them to do so.

302 The implication is that the industry would need to offer inducements to men to register and to select carefully and classify these applicants. The advantages to an employer of having available reputable skilled men are obvious. But registration would need to be attractive to such men and the industry would need to offer appropriate inducements, notably 'standby' payments, opportunities for additional training and promotion and pension entitlements.

303 The unions would need also to come to some understanding between themselves on demarcation practices. The selection, taking on and training processes would need to be based on a man's skills and not on his particular union card. The 'quid pro quo' could be the benefits given with registration, with union membership being a condition of membership of the register.

304 Would a register's cost be prohibitive? A NEDO cost/benefit analysis, admittedly rough and ready, indicates not. Estimates suggest that 12 per cent of siteworkers may be unemployed at any one time. We can err on the side of caution and take 10 per cent—or in actual terms about 3,000 craftsmen—as a working figure. Of this, 2·5 per cent may be considered 'national' unemployment, a further 2·5 voluntary unemployment (extended breaks following the

ending of jobs etc). If of the remaining 5 per cent or 1,500, jobs could be found for, say, 850 by means of a register, then the extra value of their production (on the modest assumption that each man's contribution to production is not less than his wage) would *offset* both the administrative costs of a register *and* allow the remaining 650 to be maintained on standby at their normal wage.* It is arguable, in addition, that the formation of a register would increase the proportion of men obliged to 'travel', ie to live away from home in lodgings or site camps, hence raising employment costs. It would be extremely difficult to estimate the extent of this tendency since it would be partially, possibly completely, offset through the greater information that the register would provide about work for craftsmen in their own locality.

305 We therefore recommend that the employers' associations give early detailed examination to the scope for a registration scheme. We accept that a register would not be easy to introduce or to operate and suggest that it would be prudent to start with a pilot scheme for certain craftsmen. But in recommending this we are encouraged by the promising example of the electrical contracting Joint Industry Board's labour pool which it is now hoping to extend throughout the country following successful operation in certain regions.

306 We hope that the industry would set its sights high. We believe that the long term demand on the industry will be buoyant. Because of the uncertainty of demand on individual contractors, however, and the fluctuation in total demand on the industry, we consider it impossible to provide permanent employment for all. But we suggest that by the mid 1970s the industry as a whole (through a register and through the employment policies of individual contractors) could offer permanent employment to between 20,000 and 15,000 craftsmen, or about three-quarters of craftsment at that time employed on mechanical and electrical construction; it would thus look to casual men to provide only a quarter of its skilled workforce.

307 In the meantime we hope that contractors will come to informal arrangements between themselves for the exchange of workers as projects come to an end and start—at present few such arrangements between companies appear to exist (Appendix 2, Table A.16).

Conclusion

308 We believe that the various groups that comprise this industry know that the institutions and practices suitable for industrial relations in the past are no longer relevant or effective for the changed circumstances of today. There is a need to evolve a new framework and new policies not only for immediate problems but also for the future. We believe that unless action is taken there will be a deterioration.

309 In the tangled and complex situation we have described there is no one instant solution. Indeed we question whether it will ever be possible to achieve a position of complete and lasting tidiness and clarity in the industrial relations of this industry. We have therefore put forward a group of recommendations, a 'package', to cope with the interrelated factors in the situation. Action is

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	£
*Cost of standby for 650 men @ 15s per hour on annual basis	930,000
Cost of computerised personnel register (based on an estimate by a computer bureau)	20,000
Allowance for possible additional clerical staff (On the assumption—which can be challenged—that each of 200 contractors will require an extra clerk, and that one extra clerk will be required on each of 40 sites)... ...	250,000
	£1,200,000
Benefit annually from extra 850 men in work @ 15s per man/hour	£1,200,000

required of many people. Each recommendation will require patient and persistent effort. Increased expenditure will also be entailed—in improved amenities and allowances, more training, greater use of work-study, for example—expenditure which may mean higher costs in a transitional period before these and other reforms we propose pay dividends.

310 Finally we emphasise again the key measures which are the prelude and the means to reform. The industry needs a national agreement, calling for new institutions for the orderly expression of the power structure in the industry. We have therefore called for a new alignment of the employers' associations and trade unions in the industry and the creation of a clients' council. Secondly, we re-emphasise the need for clients to intervene more actively in an attempt to bring order on to their sites, and to press their contractors to introduce the changes in management that are needed.

Chapter 5 Proposals for follow-up

311 Our recommendations call for action on a wide range of subjects by clients, contractors, unions, and by bodies serving the industry in various ways. This report has been prepared by the industry; however we see it only as starting the process of reform and consider that there is a risk that much of its value will be lost unless some means of providing a continuing stimulus to the bodies concerned is found.

312 To this end we recommend that a steering committee of representatives of the various interests in the industry should be established. This committee (which might develop into an EDC for the industry) would determine where action should be taken and monitor progress. It would also in due course give rise to the national joint council for the industry we have proposed (§ 248–251).

313 The national joint council, in addition to its negotiating functions, would be concerned with the problems of training, status and grading, with the complex of problems centred on decasualisation, and with such questions as the scope for greater flexibility at the periphery of the various skills, shop stewards facilities, grievance procedures and the means by which it can be ensured that agreements freely entered into are honoured by all parties. As we have pointed out (§ 248–251) before a joint council could be brought into being a linking of the existing employers' associations and the development of a trade union counterpart would be essential, and the steering committee would regard bringing about these developments as an important part of its remit. Similarly, it would exert pressure for the formation of a council for clients, which we think is necessary (§ 252–259) if the short term interests of individual clients with small programmes are not to undermine the long term stability and health of the industry to the detriment of clients with large and continuing programmes.

314 In addition to these important institutional developments the steering committee we have in mind would concern itself with sustaining the impetus generated by the working party on particular topics, until such time as the permanent institutions proposed were themselves able to take over this work. A detailed examination of the means to decasualisation and the introduction of the amenities code is the sort of subject we have in mind.

315 This report contains forecasts of large site activity with related manpower requirements. The Process Plant Working Party has done pioneering work with the needs of the process plant manufacturers in mind. We feel that this work should be extended to cover the needs of the large site industry as a whole. The site industry is, as our report shows, poorly documented. Its characteristics are lost within bigger employment aggregates. We think steps should be taken to put this situation right, and the steering committee we suggest could see that provision was made for the industry's wider needs on a continuing basis.

316 Finally, the contents of this report will require a major selling effort if they are to be widely adopted. The steering committee would provide the agency for organising regional conferences and the like in the immediate future for the purpose of bringing interested parties together in areas where large sites are concentrated. Action can be taken here immediately, but is unlikely to take place unless there is an industry-wide body to initiate and steer it.

Appendix 1 Industrial construction: forecasts of expenditure and manpower requirements

A.1 One of the principal tasks of Group 3 of the Working Party was to build up a picture of the likely future demand on the 'large sites' industry from the estimates of fixed capital expenditure of the main client industries during the next decade. Information on capital expenditure was received from the two main electricity generating authorities (CEGB and SSEB), petroleum refining, chemicals and allied industries, non-ferrous metals and the iron and steel industries. A further task was to use this information to give the Working Party estimates of the manpower required for plant erection work.

A.2 It must, of course, be pointed out that forecasting capital expenditure for periods beyond five years is bound to be hazardous, even in industries with traditionally long term horizons such as petroleum refining and electricity generating, and the longer term forecasts should be regarded as speculative. Ideally, the forecasts need to be updated annually, and the long term forecasts 'rolled on' by a year in collaboration with the organisations concerned (this is, of course, done already to some extent by the NEDO Process Plant Working Party).

Estimates of fixed capital expenditure

Electricity generating

A.3 Capital expenditure by the electricity generating industry was quite rightly regarded as crucial to the whole exercise. There are two principal generating Boards involved, the Central Electricity Generating Board (CEGB) and the South of Scotland Electricity Board (SSEB), and both Boards kindly gave the NEDO information on their possible construction programme during the next decade. This information included an outline of the possible construction programme for 1970–79 (reproduced in Annex 1), and the level of capital expenditure estimated by the two Boards during 1970–79 (Table A.1).

Table A.1 Power stations (CEGB and SSEB): expected annual capital investment, £m

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
256	219	176	163	152	183	230	267	330	379	377	379

A.4 Both Boards have pointed out that the capital expenditure figures are reviewed from year to year and revised in the light of future electricity demand forecasts; variations are bound to occur in the future with changing circumstances.

A.5 It seems likely that capital investment by the electricity generating industry will only begin to pick up from its present comparatively low level (though investment is still running around £180 million a year) at about 1973–74. It is then likely to rise steadily over the remainder of the decade. The expenditure programme does, of course, reflect the number of power stations under construction at various years in the decade, and the stage of construction. The outline construction programme at Annex 1 indicates that there are 15 power stations at present under construction or about to be completed; by 1973 this number will have fallen to 11, but by the end of the decade it will have risen to about 20. The implications of the programme for plant erection manpower are discussed in § A.21.

Petroleum refining

A.6 The estimates of capital expenditure by the petroleum refining industry were provided by the Ministry of Power (now Ministry of Technology). The Ministry used information supplied by the individual oil companies for the estimates up to 1972 (the coverage is considered to be virtually complete), but thereafter it relied on its own projections. The estimates (excluding land purchase) are given in Table A.2.

Table A.2 Petroleum refining: expected annual capital investment, £m

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
94	108	94	100	115	75	65	65	65	65	65	65

A.7 Capital investment by this industry is passing over a hump, during which UK refining capacity has been building up to a position of potential net exports. When this change is complete in the next year or two, it is expected that capital investment will then be confined mainly to keeping refining capacity in line with rising demand, and to the repair and modernisation of existing plant. The investment estimates for the last half of the decade are shown on a smooth path, but this could be misleading as there could again be something of a hump, followed by a lower rate of investment in the succeeding years. It is best to regard these figures more as the rate of investment over the period, rather than actual expenditure in any one year.

Chemicals and allied industries

A.8 Estimates of capital expenditure by the UK chemical industry have been supplied by the Chemical Industries' Association. The figures up to 1972 are based on a sample survey of CIA member companies, but beyond that they represent the CIA's own forecasts (Table A.3). As with petroleum refining, the longer term forecasts at best indicate the rate of investment; the well-established 5 yearly cycle of investment in the chemical industry has thus been smoothed out. The general trend of investment is perhaps best indicated by the projection in Figure 2. It has not proved possible to break down the industry into its constituent parts for investment purposes.

Table A.3 Chemicals and allied industries: expected annual capital investment, £m

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
235	280	310	280	250	315	315	315	315	315	360	360

A.9 Capital expenditure in the industry will tend to increase over the decade, though there will still be cyclical fluctuations. It is reasonable to assume that the rapid changes in technology and markets characteristic of the industry, will mean a large part of this expenditure will be in the form of new plant and equipment, particularly in major growth areas, eg petrochemicals.

Non-ferrous metals

A.10 The UK non-ferrous metals industry largely consists of the smelting and refining of aluminium, copper, lead and zinc. NEDO has made forward estimates based on past official figures for investment in the industry which have been accepted by Mintech as reasonable. Allowance has been made for the unusually high concentration of investment needed for the construction of the three aluminium smelters over the next three years. But the estimates for this industry (Table A.4) are bound to be subject to error and a single large project could result in a sizeable fluctuation in investment. The future is also more difficult to predict in view of the Government's announced intentions to encourage the development of non-ferrous ore deposits in this country.

Table A.4 Non-ferrous metals: expected annual capital investment, £m

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
27	60	98	68	50	50	51	51	46	46	46	46

A.11 The most important development in this industry in terms of large sites, is the construction of the three aluminium smelters. Briefly, their construction details are:

(i) *Invergordon, Ross and Cromarty*
A 100,000 ton capacity smelter being built for the British Aluminium Company Limited. Its capital cost will be about £37 million and the main construction period will be from the end of 1968 to first half of 1971.

(ii) *Penrhos, Anglesey*
This will also have a capacity of 100,000 tons. It is being built for Anglesey Aluminium Metal Limited, at a capital cost of some £45 million. The main construction period will be from the end of 1968 to the end of 1970.

(iii) *Lynemouth, Northumberland*
Costing some £30 million, this smelter will have a capacity of 60,000 tons. There is also a power station involved. The main construction period will run from the end of 1968 to early 1971. The client is Alcan Company Limited.

It has been estimated that the total employment in construction will be in the region of up to 2,000 jobs at each site. There may be further expansions of capacity after 1971/72 at these sites.

Iron and steel A.12 The British Steel Corporation (BSC) has announced its intention of investing some £775 million on new and replacement plant during the five years ending March 1974. It is planned to increase steel output from about 24 million ingot tons to about 30–34 million tons by 1975. It has also been announced that the rate of expenditure will be about £150–175 million annually during these years. As capital expenditure during 1969 is likely to be around £130 million, it will probably rise sharply in the early 1970s to around £190 million annually. Priority is to be given to expanding capacity in South Wales, Teesside and Scunthorpe, but there are unlikely to be any large new green-field sites on the Llanwern pattern.

A.13 The capital expenditure estimates in Table A.5 are based on BSC information up to 1973, but thereafter they are NEDO estimates. Their importance lies in the fact that they indicate that the iron and steel industry is about to start on a programme which will involve substantial industrial construction work, particularly in the early years of the decade.

Table A.5 Iron and steel: expected annual capital investment, £m

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
96	130	160	195	190	190	190	170	150	150	150	150

All industries: total expenditure

A.14 Table A.6 and Figure 2 show expected capital expenditure in the next decade in the main industry groups that can be expected to generate industrial construction work, and particularly large scale construction projects. The most significant feature is the relatively depressed level of expenditure in comparison with past years (and hence in plant erection) that can be expected from the electricity generating industry and to a much lesser extent, from the petroleum refining industry in the next few years. It is true that this will be to some extent offset by higher capital expenditure among the other industry groups, notably iron and steel. But in overall terms it looks likely that for the next two or three years industrial construction activity will decline slightly and demand on the resources of the industry will ease. From 1973 onwards, however, the estimates indicate that industrial construction in general, apart from some cyclical fluctuations, can be expected to increase steadily over the remainder of the decade.

A.15 Large green-field sites are also likely to become less common than in the past. Apart from the drop in the number of power stations under construction in the next few years, most of the expected expansion in the petroleum refining, the chemicals and the iron and steel industries is likely to be at existing large industrial complexes.

A.16 Finally, it should not be overlooked that the industry's contractors as well as meeting domestic demand, will also be competing for work in overseas markets. This is already an important part in the work-load of some contractors, and, on current trends, likely to be more generally so in the next decade.

Table A.6 Estimates of fixed capital expenditure £ million (1968 prices)

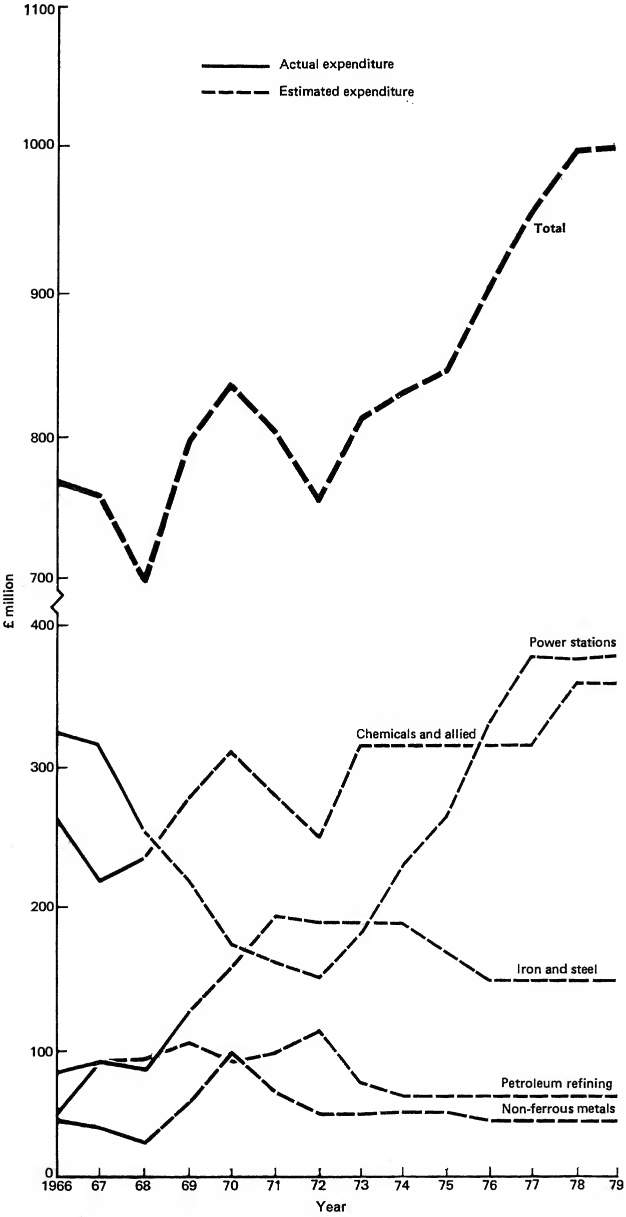
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Petroleum refining (UK)	54*	93*	94	108	94	100	115	75	65	65	65	65	65	65
Chemical and allied industries (UK)	262*	219*	235*	280	310	280	250	315	315	315	315	315	360	360
Power stations (CEGB and SSEB)	324*	315*	256*	219	176	163	152	183	230	267	330	379	377	379
Non-ferrous metals (UK)	46*	40*	27*	60	98	68	50	50	51	51	46	46	46	46
Iron and steel (UK)	84*	93*	88*	130	160	195	190	190	190	170	150	150	150	150
Total Above industries	£770*	£760*	£700	£797	£838	£806	£757	£813	£831	£848	£906	£955	£998	£1000

*Actual expenditure.

Manpower requirements

A.17 In order to assess the relationship between the industry's current labour force and the needs of the 1970s, forecasts were derived, mainly from the capital expenditure figures, of the industry's need for mechanical and electrical engineering construction labour. To claim precision for these manpower estimates would be unrealistic. But one can feel reasonably confident that they are of the right magnitude.

Figure 2 The estimates of fixed capital expenditure 1966-1979



A.18 Of all the industries, probably the most accurate estimate of manpower requirements can be derived from the data provided by the electricity generating industry for the next decade on the expected power station programme. The number of power stations which may be built, and their start and completion dates were given. Manpower requirements can thus be built up by reference to a typical demand schedule for mechanical and electrical construction labour based on previous histories of power station construction (see Table A.7).

Table A.7 Estimates of average mechanical and electrical construction labour needed to build a 2000MW conventional/1320MW nuclear power station

Year of construction						
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
10	130	690	1410	1470	790	430

A.19 The estimates of manpower needed by the electricity generating industry set out in Table A.8 have been derived from the building programme in this way.

A.20 Manpower forecasting for the plant erection work of the other industrial sectors calls for a different approach, as the only data available are those for capital expenditure. For the oil and chemical industries at least, there are accepted conventions used by the large contractors to break down capital expenditure into terms of manpower requirements. The method used by the NEDO for its estimates of manpower requirements in chemicals and petroleum refining in Table A.8, is based on the practice of a leading contractor in the industry. The method is set out in Annex 2.

A.21 The investment figures for the iron and steel and non-ferrous metals industries are more difficult to interpret in manpower terms. The manpower estimates, therefore, for construction work in these two industries have been prepared using an expenditure/manpower ratio, in line with the other industry groups, supplemented by information available on the labour needed for the large scale construction work at the Port Talbot and Lackenby steelworks, and for the three new aluminium smelters.

The manpower trend

A.22 The effect on manpower requirements for erection work of the electricity generating industry's cut-back in expenditure and construction up to 1974 is brought out in Table A.8 and Figure 3. By 1972–73 it is estimated that mechanical and electrical engineering erection labour on all power station sites will have declined to under 10,000 men from 17,000 in 1968. Only towards the end of the decade will labour requirements in this sector approach the high levels of recent years. Following a similar pattern, though on a much reduced scale, is petroleum refining, where labour requirements look like stabilising around the 3,700 mark over the decade.

A.23 There will probably be a long term increase in construction labour requirements from the chemicals and allied industries and the iron and steel industry, and in the short run, from the non-ferrous metals industry. The overall picture, therefore, points to a fall in the demand for plant erection labour in the two or three years after 1970, but to a steady, though fairly slow, build up in demand over the remainder of the decade.

A.24 No allowances have been made in Table A.8 for any productivity increases that may occur in the use of plant erection labour over the next decade. It seems plausible to assume a future rate of increase in productivity of about

3 per cent (though this is slightly below the rate of increase in the construction industry as a whole over recent years). The precise impact of such gains on labour needs is very difficult to gauge in this industry in the absence of the relevant data, but on a crude estimate, it could be assumed that the total manpower requirement by the end of this decade, if this level of productivity increase was maintained, would be some 10,000 less than now forecast, i.e a total labour requirement of about 40,000 men.

Table A.8 Estimates of manpower required for mechanical and electrical engineering construction, 1968–79, by industry

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Petroleum refining	5400	6200	5400	5700	6600	4300	3700	3700	3700	3700	3700	3700
Chemicals and allied industries	13400	16000	17700	16000	14200	18000	18000	18000	18000	18000	20500	20500
Power stations	16800	16800	15200	11400	9000	8500	10600	12200	14800	16900	18100	17500
Non-ferrous metals	1400	3200	5200	3600	2700	2700	2700	2700	2400	2400	2400	2400
Iron and steel	4700	6900	8500	10300	10100	10100	9000	8000	8000	8000	8000	8000
Total	41700	49100	52000	47000	42600	43600	44000	44600	46900	49000	52700	52100

A.25 Labour released by productivity gains might be counterbalanced by demand from other large industrial projects ignored at this stage which might well be a reality in the next ten years or so. In this category fall projects such as large desalination, carbon fibre, or natural gas processing plants.

Annex 1

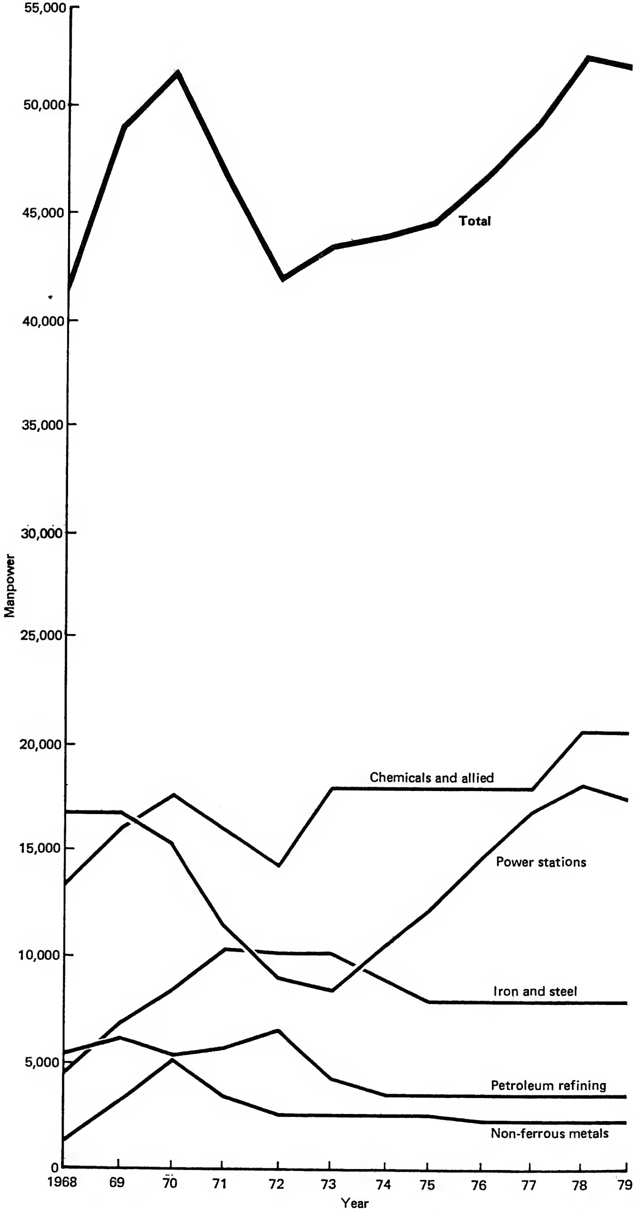
Table A.9 *Electricity generating: likely power station programme, 1970–1979* (CEGB *and* SSEB)

Power stations	Starts	In building	Completions	Total
1970	3	12	3	18
1971	2	12	3	17
1972	2	9	5	16
1973	2	9	2	13
1974	4	10	2	16
1975	4	14	—	18
1976	3	16	2	21
1977	3	18	2	23
1978	3	18	3	24
1979	2	18	3	23

1 The power station programmes were formulated in 1969 and earlier, and extrapolated as the basis of the 1969 estimates. In the years from about 1974 onwards the figures do not imply any firm commitment to construct.

2 In addition to this programme, the SSEB is collaborating with the North of Scotland Hydro Electric Board on the construction of a 300MW pumped storage plant at Foyers, near Loch Ness, which should be in service in 1974. There is also the prototype fast-breeder reactor of 250MW under construction for the UKAEA at Dounreay, Caithness. This should be completed by about 1971.

Figure 3 . Estimates of manpower requirements (mechanical and electrical engineering operatives)



Annex 2 *Statistical method of arriving at labour requirements from a total installed cost (refinery and petrochemical plants)*

(a) Assume total installed cost (TIC) = £10m

(b) Proportion of labour (including subcontracts) = 18% x TIC = £1·8m

(c) Of which, non-mechanical and electrical labour:

Civil work — 15% of total labour cost
Buildings — 2% ,, ,, ,, ,,
Concrete structure — 2% ,, ,, ,, ,,
Insulation — 6% ,, ,, ,, ,,
Fire-proofing — 1% ,, ,, ,, ,,
Painting — 4% ,, ,, ,, ,,
Total 30%

(d) Hence mechanical and electrical labour = 70% x labour cost
= 70 x £1·8m
= £1·26m

(e) Current average labour cost (including basic, productivity and flexibility allowances, premium time, social benefits, lodging and radius allowances, periodic travel, etc)

= £1·1 per man hour

(f) Direct labour man hours $= \frac{£1{\cdot}26\text{m}}{£1{\cdot}1}$

= 1,145,000 man hours

(g) £10m of TIC = 1·145m man hours

(h) Average mechanical and electrical labour force with 40 hour week and 50 week year:

40 hour work week $= \frac{1{,}145{,}000}{50 \text{ x } 40} = 572$ men a year

Appendix 2 The survey among contractors

A.26 In order to obtain information about the size and nature of employment in the industrial construction industry, the hours of work and earnings of large site operatives, employers' personnel policies, and other related matters, Group 3 of the Working Party commissioned a survey among contractors which was carried out in May 1969. The survey was prepared in consultation with the Group, and carried out by the National Economic Development Office (NEDO) under the technical direction of its statistical section. The main findings of the survey are as follows.

Summary and conclusions

A.27 There were 86 contractors taking part in the survey. The survey covered nearly 27,000 operatives engaged on industrial construction work generally, of which almost 17,000 were employed on large sites. In all, data were received on 43 of the NEDO list of large sites. About 90 per cent of the large site operatives were either working on power station sites or on oil and chemical plant sites. Nearly three-quarters of the operatives surveyed were classified as craftsmen.

A.28 The total value of all the contracts covered by the survey for large site work was £420 million, of which £118 million was subcontracted. Roughly one-third of the total contract value, or £131 million was due to be carried out during 1969.

A.29 Taking employment in the industry as a whole, it is clear from the survey that it is characterised by a high degree of instability. Only just over one-third of the total craftsmen surveyed were regarded by their employers as permanent employees, and the proportion was even lower among the semi-skilled and the unskilled. The major oil and chemical plant contractors were clearly facing the greatest problem in maintaining continuity of employment, and less than one in five of the craftsmen employed by them during the survey week was regarded as a permanent employee. A number of them mentioned that as long as their work load fluctuated they could not carry a permanent labour force.

A.30 Labour turnover, not surprisingly, is also very high, even in comparison with the construction industry generally. It appears to be particularly high among the major oil and chemical plant contractors. In the industry as a whole, about one-fifth of the craftsmen had been employed by their contractors for less than 6 months at the time of the survey. Only 18 per cent had been employed for over 5 years. The most stable employment in the industry seems to be amongst the electrical engineering contractors, and the specialist heating and ventilating, and insulating engineers.

A.31 In an effort to improve continuity of service, the survey showed that virtually all the contractors were making some attempt to transfer operatives from site to site within the company or group as a contract ended or as the need arose. But the high instability and turnover raises doubt as to the effectiveness of such policies, and the survey indicated that many of the so-called transfer schemes apply only to key personnel and not to operatives generally. There was some evidence that local union rules and regulations and bonus expectations inhibited the transfer of employees. Transfer schemes between companies were virtually non-existent.

A.32 Most employers were offering some form of incentive or encouragement to operatives to remain in their employ. The most popular appear to be promotion schemes and training courses. It is questionable whether the operatives in fact regarded such incentives as inducements to stay, and more likely as normal benefits generally expected in employment today.

A.33 About one-half of the operatives leaving large sites during the 12 months prior to the survey had been discharged, and the other half had left voluntarily. The majority of the operatives discharged had been so because of completion of work, though the electrical engineers had dismissed a relatively large proportion of their workers on disciplinary grounds (33 per cent), and the boilermakers for refusing to travel (37 per cent).

A.34 The most widespread method used by companies in the industry to select craftsmen and other operatives at the site was a check with the former employer. This was particularly true of the specialist engineering contractors. However, roughly one half of the returned site questionnaires indicated that no such check had been made and there would appear to be room for improvement here. Trade tests were used surprisingly little to select craftsmen on site, with the exception of welders.

A.35 Recruitment at site level was done mainly by the site engineer and, to a lesser extent, the general foreman. Few contractors considered it worthwhile to employ a personnel officer at site with specific responsibilities for recruiting. In fact the total number of personnel/labour relations officers working full time at large sites during the survey week was only about 30, and the majority were employed on oil and chemical plant sites. Despite the widespread use of incentive payment schemes, the number of full time work study officers (less than 40) on large sites was also low, and they were employed by less than one-fifth of the contractors surveyed. It should be borne in mind, however, that site management generally would have at least some experience and training in both these fields, and that some companies have reservations about using specialists for such work.

A.36 The survey showed that the craftsmen in the industry were fairly mobile. Nearly 40 per cent of the craftsmen employed on large site work could be classified as travellers, by virtue of the fact that they were living in local lodgings or camps. It was not possible to tell how many were permanently employed travellers or casual, though it would seem probable that a fairly high proportion were in fact permanent employees, at least among the more specialist contractors. Qualitative evidence from the survey, however, suggested that men were becoming less willing to travel.

A.37 Most of the contractors reported particular difficulty in recruiting welders and pipefitters. Erectors/riggers, apart from those with experience of tank erection, were proving the least difficult to recruit. There were no major changes foreseen in skill shortages over the next five years and welders in particular are likely to continue to be in short supply. It is worth noting, however, that shortages of skilled workers were not seen by companies as a really major cause of delay in completing their contracts on time.

A.38 The average weekly earnings (including taxable travelling and lodging allowances) of skilled craftsmen on large sites were generally between £36 and £44 (£33 and £40 excluding allowances), which is well above the average weekly earnings in the engineering industry for skilled workers (about £27) and construction generally (about £23). Average weekly earnings were highest among the welders (£44) and erectors/riggers (£39) though the spread of earnings within the trade was more marked among the latter. Semi-skilled workers (£31) and labourers (£27) on large sites were also earning substantially more than their counterparts in engineering and construction generally.

A.39 Average weekly earnings were higher on CEGB sites than oil and chemical plant sites for all groups of operatives, mainly because companies on power station sites, notably the boilermakers, were paying higher bonuses than elsewhere and to a lesser extent because of higher travelling and lodging allowances. Virtually all the general engineering contractors and boilermakers were in fact running company bonus schemes for their siteworkers, but this was not true of the oil and chemical plant contractors.

A.40 Operatives in each skill group on large sites were substantially exceeding their basic pay by any one, or a combination of, bonus, overtime pay, travel and lodging allowances or other payments. On CEGB sites, the proportion of total weekly earnings represented by the basic pay never exceeded one-half in each group of operatives surveyed, with the exception of the electricians.

A.41 Average hours of overtime ranged from 6 to 10 hours a week according to the trade. In some companies, clearly excessive amounts of overtime were being worked. Overtime earnings were high for the electricians and insulators on power station sites, particularly nuclear.

A.42 There was evidence from the earnings survey that weekly earnings frequently varied widely between companies on the same site for workers in the same skill group and for reasons which were not always apparent at first sight. This was most notable on CEGB power station sites.

A.43 The survey underlined the fact that late design changes and late delivery of plant and materials were grave problems facing the industry. By most of the contractors taking part in the survey, they were recognised as the major causes of delay in completing contracts for large site work. Low labour productivity was also a cause of widespread concern, particularly by the major oil and chemical plant contractors. Labour disputes were not generally ranked high as a cause of delay, though they were given somewhat greater prominence by the general and specialist engineering companies.

The contractors and their labour force

A.44 In total there were 86 head office questionnaires and 260 site questionnaires returned to NEDO by the private contractors participating in the survey. The 260 site questionnaires covered 43 of the NEDO list of large sites (see p. 96).

A.45 Table A.10 shows how the 86 head office questionnaires were classified by NEDO according to type of company, together with the total industrial construction labour force (on small as well as on large sites) employed by the companies at the time of the survey (May 1969).

Table A.10 Coverage of survey: head office questionnaires

Type of company	Number of head office questionnaires returned	Total industrial construction labour force
Major oil and chemical plant contractors	17	7693
Constructional steelwork and general engineering	20	2145
Electrical engineering and cables	22	5718
Instrumentation	4	306
Boiler erection	4	4830
Tank erection, pumps, pipework and valves	14	4254
Heating and ventilating insulating, and painting contractors	5	1944
All companies	86	26890

A.46 Most of the 86 contractors had employees on one or more of the NEDO list of large sites, and therefore completed the large site questionnaire. The site questionnaires have been classified according to type of company in Table A.11, and the total large site labour force covered has been specified in each case.

Table A.11 Coverage of survey: large site questionnaires

Type of company	Number of site questionnaires returned	Total operatives on large sites
Major oil and chemical plant contractors	27	5544
Constructional steelwork and general engineering	49	1282
Electrical engineering and cables	77	3326
Instrumentation	14	262
Boiler erection	22	3105
Tank erection, pumps, pipework and valves	43	2159
Heating and ventilating etc	28	885
All companies	260	16563

Table A.11 shows, therefore, that the major oil and chemical plant contractors were employing one-third of the total large site labour force identified by the survey returns. Electrical engineering contractors and the boiler erection contractors were each employing about one-fifth.

road skill groups

A.47 The survey showed that of the total operatives both on large site work alone, and on industrial construction generally, some 70 per cent were craftsmen, about 20 per cent were semi-skilled, and the remainder were unskilled. The labour forces of each of the major contractor groups varied little from the overall pattern.

Table A.12 Occupational groups of craftsmen

	Craftsmen on all industrial construction work		Craftsmen on large site work	
	No.	%	No.	%
Pipefitters	3208	18	1924	17
Fitters/millwrights	2257	13	1299	11
Welders	2744	15	1699	15
Platers/boilermakers	841	5	561	5
Plumbers	319	2	225	2
Insulators	657	4	255	2
Erectors/riggers	3558	20	2227	19
Scaffolders	608	3	535	5
Electricians	1871	10	1738	15
Crane drivers/equipment operators	451	3	362	3
Industrial painters	468	3	264	2
Other trades	928	5	390	3
Total	17910	100	11479	100

A.48 The craftsmen covered by the survey can be further broken down into occupational groups. Again, data were provided for all industrial construction work, and large site work alone (Table A.12). The erectors/riggers made up the largest single occupational group in both cases.

Large sites

A.49 The total of 16,563 large site operatives covered by the survey were working on the types of large site shown in Table A.13.

Table A.13 Operatives by type of large site

Type of site	Total operatives employed on large sites No.	Percentage of total large site operatives %
CEGB conventional power station	6931	42
CEGB nuclear power station	875	5
SSEB power station	708	4
Iron and steel and gas plant	515	3
Oil and chemical plant	7534	45
All sites	16563	100

A.50 Between them, therefore, CEGB conventional power station sites and oil and chemical plant sites accounted for nearly 90 per cent of the total site operatives. Many of the comparisons consequently in this report are between these two types of site.

Value of contracts

A.51 Contractors were asked to state the total value of the contracts they held for all mechanical and electrical engineering construction on large sites, and the proportion subcontracted. (This question was in fact completed by 82 contractors.) As Table A.14 shows, the total value of all contracts for large site work held by the contractors came to over £420 million, of which 28 per cent or about £118 million had, or was to be, subcontracted.

A.52 In terms of total value of work, the oil and chemical plant contractors with over £120 million had the highest amount of work on hand on large sites. However, looked at in terms of average value of total contracts held (not average value of individual contracts), the average was easily highest among the boiler erection contractors. (£22 million as against the all company average of £5 million.)

A.53 The proportion of subcontract work was highest among the electrical engineering contractors, though it should be pointed out that this was due mainly to the weight given in this group to the turbine contractors; in fact many of the companies in this category were themselves subcontractors with therefore a low proportion of subcontract work.

A.54 The survey questionnaire also asked contractors to state roughly the proportion of their contracts that they intended to carry out during 1969. (Table A.14) About one-third of the total work load was likely to be carried out during 1969, or approximately £131 million. The oil and chemical plant contractors were planning on carrying out well over one-third of their work load, whereas, on the other hand, the boiler erection contractors with their largely high value long term contracts thought the proportion would be only some 21 per cent.

Table A.14 Large sites: contract values

Type of company	No. of companies	Total value £m	Average value £m	Sub-contracted %	To be carried out in 1969 %
Major oil and chemical plant	17	122	7·2	31	38
Constructional steelwork, and general engineering	18	53	3·0	25	29
Electrical engineering and cables	21	115	5·5	37	27
Instrumentation	4	2	0·6	1	39
Boiler erection	4	88	22·0	26	21
Tank erection, pipework etc	13	20	1·5	7	55
Heating and ventilating etc	5	22	4·3	9	37
All companies	82	422	5·1	28	31

Managerial policy on employment

A.55 The contractors were asked about managerial policies towards the employment of site erection workers, in particular the attitude of contractors towards keeping their labour force together. One would expect certain differences in this respect due to the size of the firm, its type of work, and the use of sub-contractors, and this chapter brings out clearly the difficulties facing the big contractors in holding labour on a continuous basis.

Permanent employees

A.56 The survey asked contractors to state roughly what proportion of their site operatives employed on mechanical and electrical engineering construction were regarded as permanent for all practical purposes. Separate answers were given for the craftsmen, the semi-skilled operatives, and the unskilled operatives.

Craftsmen

A.57 Just over one-third of the total craftsmen employed as site operatives by the contractors participating in the survey (around 18,000 men) were regarded by the contractors as permanent employees (Table A.15). This may well be a somewhat inflated figure, bearing in mind that this was an estimate made probably at head office and could represent more of a hope than a reality.

Table A.15 Proportion of site operatives regarded as permanent employees

	Craftsmen %	Semi-skilled %	Unskilled %
Major oil and chemical plant contractors	18·5	17·2	19·5
Constructional steelwork, and general engineering	42·1	16·8	0·6
Electrical engineering	55·8	36·4	11·3
Instrumentation	31·5	22·4	0
Boiler erection	32·2	28·4	0·3
Tank erection, pipework etc	47·4	31·3	64·8
Heating and ventilating etc	57·9	61·4	36·9
All companies	37·1	30·4	16·8

A.58 The company analysis brings out the fact that the major oil and chemical plant contractors were much less likely to view employees as permanent than were the other types of contractor. Probably because of the large fluctuations in their work loads, they regarded on average less than one-fifth of their craftsmen as permanent employees, a state of affairs incidentally most of them deprecated. At the other extreme, the corresponding proportion among specialist contractors such as electrical engineering and heating and ventilating, was well over one-half.

A.59 As one might expect, the smaller the company, the more likely were craftsmen to be regarded as permanent. The proportion of craftsmen regarded as permanent in companies employing less than 100 men was in fact as high as two-thirds.

Semi-skilled and unskilled operatives

A.60 The numbers involved here are a good deal less than for craftsmen, and the results of the survey have therefore to be treated with caution. The survey showed that on average 30 per cent of the semi-skilled operatives (1,750 men) employed by the survey contractors were regarded as permanent, and only 17 per cent of the unskilled (540 men). As with the craftsmen, it was generally the oil and chemical plant contractors who had the lowest proportions of permanent employees.

Site transfer of operatives

A.61 One way in which employers could increase the proportion of permanent operatives, is to have some means by which they can move men from site to site as a contract ends or as the need arises. Employers, therefore, were asked in the survey whether or not they operated a centralised or regional system which enabled operatives to be transferred from site to site within the company or group.

A.62 As Table A.16 indicates, about 90 per cent of all the contractors taking part in the survey reported that they were operating such a system. The small number of contractors admitting to not operating such a system were all oil and chemical plant contractors. It seems probable however that the question was interpreted fairly liberally, and that many of the so-called transfer schemes among the more specialist contractors were very flexible and informal.

A.63 In the opinion of some contractors in the survey, the transfer of men from one region to another was inhibited by trade demarcation rulings and union district policies. The prospect of lower bonus earnings was also another factor in reducing mobility.

Table A.16 Companies operating transfer schemes for site operatives

	Within the company		Between companies	
	Yes	No	Yes	No
Major oil and chemical plant contractors	9	8	3	14
Constructional steelwork and general engineering	20	0	2	18
Electrical engineering	22	0	2	20
Instrumentation	4	0	0	0
Boiler erection	4	0	2	2
Tank erection, pipework etc	14	0	0	14
Heating and ventilating etc	5	0	1	4
All companies	78	8	10	76

A.64 As a corollary to the question of transfer within a company or group, contractors were also asked whether or not they operated a transfer scheme in conjunction with other companies. It appears that such schemes are very limited indeed. Only ten contractors acknowledged that they did operate a transfer scheme with other companies.

Incentives to remain with the company

A.65 As another way of assessing employers' attitudes towards employees in the industry, contractors were asked what special encouragements they were offering craftsmen and other operatives to remain in their employ. A list of possible encouragements was given to contractors in the questionnaire.

A.66 The response showed that perhaps with the exception of long service pay, all the encouragements listed in the questionnaire were fairly widespread within the industry (Table A.17). The incentive or encouragement offered most by contractors both to craftsmen and to other operatives was a promotion scheme within the company. Training courses were also apparently widespread. All four of the boiler erection contractors taking part in the survey were offering pension schemes to their craftsmen. The results suggest that the major oil and chemical plant contractors were less likely to offer inducements to stay than other types of contractors, which reflects their greater reliance on casual employment.

Table A.17 Incentive offered to remain with the company (Percentages of total survey contractors offering the incentive)

	Pension scheme	Long service pay	Promotion policy	Training courses	Other
All companies %	48	21	91	62	14

Labour turnover and stability

A.67 In the last section the general attitude of the employers in the industry towards continuity of employment was examined. This section analyses the results of three further questions in the survey designed to make a deeper quantitative assessment of the casual nature of the industry, and the reasons why employers were discharging labour.

Labour stability

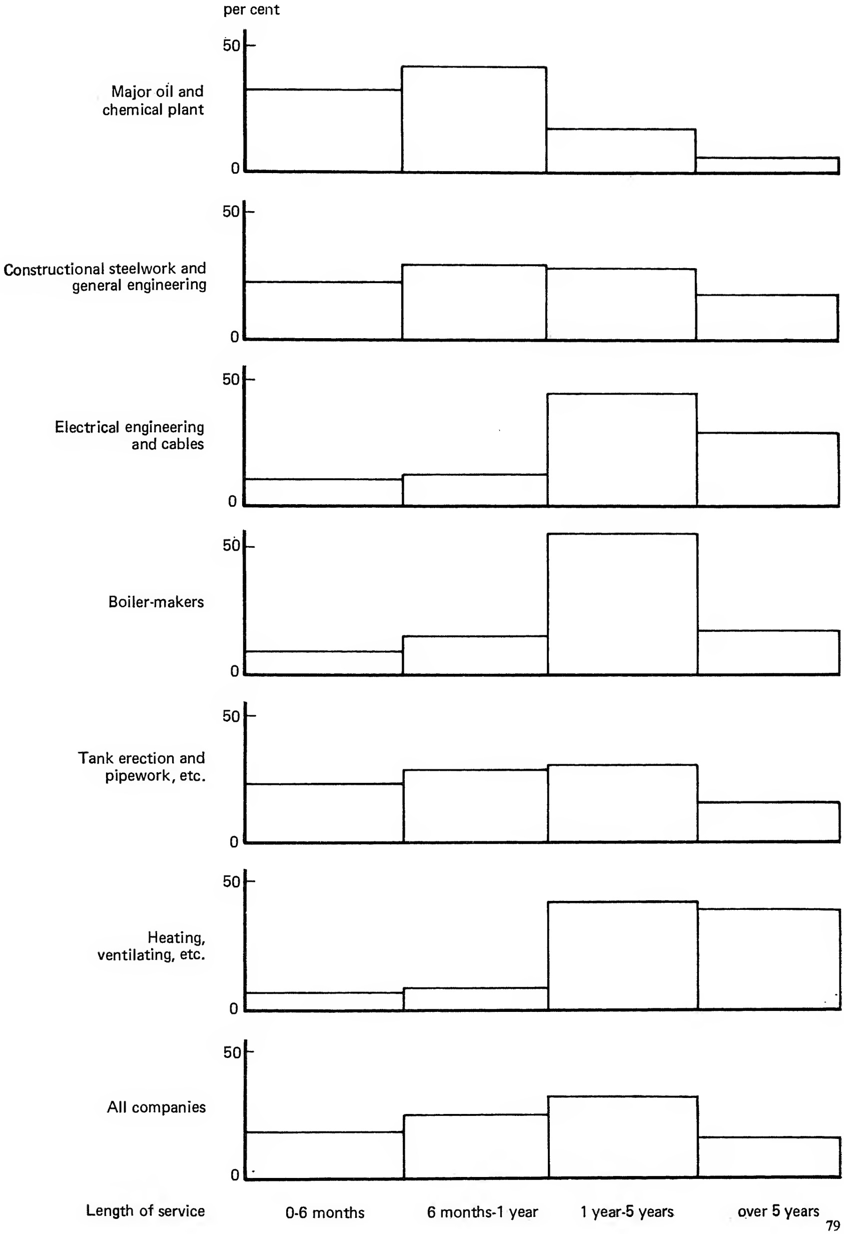
A.68 Contractors were asked to state roughly what proportion of their site operatives had been continuously employed by them for specific periods of time. Separate analyses are possible for craftsmen, semi-skilled and unskilled operatives.

Craftsmen

A.69 Nearly 18,000 craftsmen working on industrial construction work were covered by the survey, and 21 per cent, or about 3,800, had been with their companies for a period of less than six months. Just over one-half of the total had been continuously employed by one company for over one year, and 18 per cent for over 5 years. (Table A.18)

A.70 Table A.18 and Figure 4 show that there were differences in employment stability between the various types of contractors. Stability was lowest (apart from instrumentation contractors where the numbers are too small to be reliable) among the major oil and chemical plant contractors. One-third of their total employees were estimated to have been with their companies for less than six months, and only one-quarter had been continuously employed for over one year. The other large companies taking part in the survey, notably the boiler erection contractors, had a much higher stability rate. But the specialist contractors, such as the heating and ventilating engineers, and insulating engineers,

Figure 4 Length of service: craftsmen



had the most stable labour forces. Over 80 per cent of their total craftsmen had been continuously employed by their employers for over one year.

Table A.18 Duration of employment of craftsmen with company

	Less than 6 months %	6 months–1 year %	1 year–5 years %	Over 5 years %	Total nos.
Major oil and chemical plant	33·5	42·3	17·4	6·8	5594
Constructional steelwork and general engineering	23·1	30·1	28·4	18·4	1749
Electrical eng. and cables	10·6	12·9	45·8	30·8	2891
Instrumentation	33·4	39·1	17·3	10·3	212
Boiler erection	9·9	16·3	56·1	17·8	3193
Tank erection, pipework etc.	24·2	29·6	30·5	15·8	2936
Heating and ventilating etc	7·6	9·1	43·3	40·0	1335
All companies	21·1	27·1	34·0	17·8	17910

Semi-skilled A.71 It appeared from the survey that the employment of semi-skilled operatives in the industry was more stable than craftsmen. Over 60 per cent of the total employed (compared with around 50 per cent for craftsmen) had been with their companies for over one year.

Unskilled A.72 The unskilled operatives in the industry, and there were just over 3,000 covered by the survey, were apparently the least stable of all three groups of workers. About 60 per cent or 1,900 men had been continuously employed for less than one year by their present company. Amongst the oil and chemical plant contractors and constructional steelwork contractors stability was even lower—about 80 per cent and 90 per cent of unskilled workers respectively had been with their firms for less than one year.

Table A.19 Estimates of labour turnover

	Total large site labour force	Total leavers from large sites in past year	Annual turnover %
Major oil and chemical plant contractors	5544	10712	193
Constructional steelwork, and gen. eng.	1282	1089	85
Electrical engineering etc	3326	3106	93
Instrumentation	262	176	67
Boiler erection	3105	2554	82
Tank erection, pipework etc	2159	829	38
Heating and ventilating etc	885	1350	153
All companies	16563	19816	120

(For comparison purposes, the labour turnover rate in 1966–67 in the construction industry generally ranged from about 45% to 124% according to size of firm.)

Labour turnover

A.73 The survey questionnaire asked each contractor to provide data on the number of operatives (including unskilled) leaving their employment on large sites during the 12 months prior to the survey date (week ending the 16 May 1969). The reasons for leaving were also requested. An estimate of the extent of labour turnover in the industry can be made by comparing the numbers of employees leaving during the 12 month period, with the total number of employees on their books during the survey week (Table A.19).

A.74 One might expect the larger, more general contractors to experience a higher turnover among their labour force than the more specialist contractors, and this is shown clearly in Table A.19. The turnover rate among oil and chemical plant contractors was approaching 200 per cent, substantially higher than among most other groups of contractors in the industry. It is surprising that the heating, ventilating, and insulating, etc contractors should show such a relatively high turnover rate (153 per cent) in view of their high stability rate, and this probably indicates a fairly small number of short-term employees were changing jobs among these contractors quite frequently.

A.75 It is interesting to note that the lowest labour turnover on large sites by a long way was among the tank and pipe erection contractors. Their turnover rate at 38 per cent is in fact only one-third of that in all companies.

Reasons for termination of employment

A.76 The survey showed that in the year ended May 1969 roughly one-half of the large site leavers had been discharged, mainly on redundancy grounds, and the other half had left on their own accord. The distinction between the two main reasons for leaving must be a fine one. A worker expecting to be discharged very shortly because his work is virtually complete, may well decide to leave voluntarily.

Table A.20 Reasons for leaving large site work (all operatives)

	Retirement/ ill health %	Voluntary %	Discharges %	Other reasons %	Total leavers
Major oil and chemical plant contractors	1·0	47·4	50·9	0·7	10712
Constructional steelwork, and gen. eng.	3·1	26·0	69·8	1·1	1089
Electrical engineering, and cables	2·5	60·4	36·8	0·3	3106
Instrumentation	1·8	35·8	62·5	—	176
Boiler erection	2·2	28·6	68·0	1·1	2554
Tank erection and pipework etc	3·4	37·0	55·1	4·5	829
Heating and ventilating etc	3·6	51·7	44·7	—	1350
All companies	1·8	45·6	51·8	0·8	19816

A.77 Table A.20 shows that voluntary leaving was more likely among operatives employed by electrical engineering contractors than among others, but much less so among the general engineering contractors and the boilermakers. In fact only 29 per cent, of all leavers, or 740 operatives, had voluntarily left the boilermakers during the past year. This means of course, that the proportion of leavers discharged was correspondingly much larger than other contractors.

Reasons for discharging operatives

A.78 The contractors were also asked to indicate the main reasons why they had to discharge operatives during the 12 month period up to May 1969 from large sites. In total, there were 10,266 operatives discharged by the survey contractors, or 52 per cent of the total leavers.

Table A.21 Reasons for discharges from large sites (all operatives)

	For disciplinary reasons %	Completion of work %	Refusal to travel %	Other %	Total discharges No.	Total discharges %
Major oil and chemical plant contractors	3·3	91·7	1·4	3·6	5455	(100)
Constructional steelwork, and gen. eng.	4·5	73·1	13·8	8·6	761	(100)
Electrical engineering, and cables	33·1	55·6	4·0	7·3	1142	(100)
Instrumentation	14·6	67·8	1·5	16·2	110	(100)
Boiler erection	6·8	49·5	37·0	6·6	1737	(100)
Tank erection and pipework etc	9·0	62·4	15·4	13·2	458	(100)
Heating and ventilating etc	20·2	54·2	3·8	21·8	603	(100)
All companies	8·7	75·4	9·4	6·6	10266	(100)

A.79 The oil and chemical plant and the boilermakers between them accounted for over two-thirds of the discharges. The analysis in Table A.21 shows that amongst all firms surveyed, on average three-quarters of those discharged had been so because the work for them on site had been completed. Other reasons for discharges, such as refusing to travel, were comparatively unimportant.

A.80 But the more detailed analysis by type of contractors shows that whereas virtually all those discharged by the major oil and chemical plant contractors had been so because of completion of work, this was by no means the case among the important groups of the electrical engineering contractors and the boilermakers. Amongst the former, a relatively large proportion (33 per cent) had been discharged on disciplinary grounds, and with the boilermakers, refusal to travel emerged as a significant reason for discharge (37 per cent). The fact that this reason was virtually non-existent among the oil and chemical plant contractors suggests that they were not generally able to offer their employees alternative large site work, and that their employment policies were geared to employing operatives who would not be expected to travel from site to site with the company.

The recruitment of operatives and skill shortages

A.81 This section looks at some aspects of recruitment of operatives by contractors at site level, together with an appraisal of current and expected difficulties in recruiting different types of craftsmen.

A.82 Contractors were given a list of possible selection methods, and asked to state which one was the main method used by them before an operative was engaged at the site. The results were unsatisfactory, in that there was a tendency for respondents to state more than one main method, and some interpretation was required. The results, therefore, need to be used with caution.

A.83 Of the few main selection methods used to select craftsmen and other operatives at site—formal interview, completion of questionnaire, trade test, check with former employer—it seems probable from the survey, that the most popular selection method in the industry generally was a check with the former employer. Roughly half of the site questionnaires pointed to this as a main selection method in use for both types of employees. The trade test appeared to be widely used when welders were being recruited, but not important for selecting other craftsmen on site. Of the 260 site questionnaires, 37 showed that craftsmen were being selected by means of the formal interview alone. The point should also be made that it was evident from the survey that by no means all contractors were in fact recruiting at site level, and preferred to recruit and select at head office only.

Person responsible for recruitment at site

A.84 As well as their main method of selection, the contractors were asked to indicate the grade of person responsible for recruitment on site. Table A.22 shows that so far as craftsmen were concerned, over one-half of the total site questionnaires returned indicated that the site engineer was the person responsible for recruitment. To a slightly lesser extent, the site engineer was also the most important recruitment officer among other operatives (45 per cent of total questionnaires). The site engineer was particularly dominant among the boiler erection contractors.

A.85 The site engineer was responsible for most of the recruiting on site by the boilermakers, but the oil and chemical plant contractors appear to be more likely to have an industrial relations officer responsible for recruiting at site than other contractors. This is not surprising, in view of the size and nature of contract many of them hold at site, and the number of operatives they would need to recruit. Roughly, one-third of the site returns from the oil and chemical plant contractors (who covered some 5,500 operatives) indicated that both craftsmen and operatives were being recruited by an industrial relations officer (Table A.22).

Table A.22 Grade of person reponsible for recruitment at large sites

		Site engineer	Ind. Rel. officer	Gen. foreman	Other	Total large site questionnaires
Major oil and chemical plant contractors	*Craftsmen*	9	8	0	10	27
	Other operatives	3	10	11	3	27
Constr. steelwork and gen. engineering	*Craftsmen*	14	4	12	19	49
	Other operatives	12	2	13	22	49
Electrical engineering and cables	*Craftsmen*	47	2	18	10	77
	Other operatives	44	2	20	11	77
Instrumentation	*Craftsmen*	11	0	1	2	14
	Other operatives	10	0	2	2	14
Boiler erection	*Craftsmen*	19	3	0	0	22
	Other operatives	19	3	0	0	22
Tank erection, pumps and pipework etc	*Craftsmen*	26	4	3	10	43
	Other operatives	23	5	5	10	43
Heating and ventilating etc	*Craftsmen*	7	2	11	8	28
	Other operatives	7	1	13	7	28
All companies	*Craftsmen*	133	23	45	59	260
	Other operatives	118	23	64	55	260

Operatives living in local lodgings or camps

A.86 A question was included in the survey designed to get information on the proportion of workers on site who had been recruited locally, or had to be brought in from outside and were living in local lodgings or camps (the travellers). The results of this question are shown in Table A.23.

Table A.23 Percentage of operatives living in local lodgings or camps

	Size of companies' labour force on site				
	1–49	50–99	100–499	500+	Total
Craftsmen %	49·6	40·8	31·3	40·3	38·6
Semi-skilled %	14·7	11·0	20·3	1·3	13·7
Unskilled %	2·5	6·9	7·0	4·7	5·8

A.87 Table A.23 shows that well over one-third of all the craftsmen covered by the survey (and there were a total of 11,479), were either living in local lodgings or camps, and therefore away from their homes. The comparable proportion, as one might expect, was noticeably lower among semi-skilled and unskilled operatives. It would seem from the survey that the small contractors, probably the specialists, have to depend relatively less on local labour markets than the larger firms, and can make greater use of travellers.

A.88 It would be wrong to assume that the 60 per cent or so of the craftsmen who were living at home at the time of the survey would not also be willing to travel given the necessary inducements. Nevertheless, some opinions in the survey did point to the fact that on the whole travelling men were decreasing in numbers.

Skill shortages

A.89 So as to get some information on recruitment problems and possible training needs, the contractors were asked to indicate the degree of difficulty they were having at present to recruit certain site erection skills, and how they saw the situation developing, over the next five years.

A.90 The majority of the contractors taking part in the survey had experience of employing welders, and about one-third of them said they were having severe difficulty at the moment in recruiting them. On the other hand, there were also a fair number (about one-quarter) who said that there was no difficulty, and it would seem much would depend on what type of welder was being sought. Presumably, most difficulty was being had in recruiting API/ASME (Grade 1) standard welders.

A.91 The only other skill where there was strong evidence of a tightness in the labour market was for pipefitters. It is worth noting that the majority of companies were apparently having no difficulty in recruiting erectors/riggers with the exception of erectors with knowledge of tank erection.

A.92 Turning to the future, the survey results show that few companies were expecting much change in the situation (though much would depend on the number and type of their contracts). Some 60 per cent of the contractors employing welders considered that they would have about the same or less difficulty in recruiting this skill over the next five years.

The employment of specialist staff

A.93 This section provides an indication of the extent to which the contractors were employing full time specialist staff for certain work. Care must be taken in interpreting the results, because a number of companies, including large ones, preferred to leave such questions as industrial relations to their general site management, rather than to employ specialist staff.

Personnel/industrial relations officers

A.94 The number of full time personnel/industrial relations officers employed was small, bearing in mind the coverage of the survey. There was a total of 29 employed full time on all industrial construction sites during the survey week, 16 of whom were employed by the major oil and chemical plant contractors in the survey, and 6 by the boilermakers. Of the total engineering and constructional steelwork contractors (20) in the survey, only one contractor considered it worthwhile to employ a personnel/industrial relations officer full time on the site, probably because in many cases the numbers of operatives did not appear to warrant it. In terms of the overall ratio of personnel/IROs to all site employees, the boilermakers compared unfavourably with other contractors (Table A.24).

Table A.24 Numbers of personnel officers by type of employer

	Personnel/IROs			Total industry employees	Ratio of total IR staff to employees
	At head office	At all sites	Total		
Major oil and chemical plant contractors	30	16	46	7693	1:167
Constructional steelwork and gen. eng.	13	1	14	2145	1:153
Electrical engineering and cables	39	2	41	5718	1:139
Instrumentation	2	0	2	306	1:153
Boiler erection	5	6	11	4830	1:439
Tank erection, pipework etc	15	4	19	4254	1:224
Heating and ventilating etc	15	0	15	1944	1:130
All companies	119	29	148	26890	1:182

Planning and progress officers

A.95 The survey asked contractors to state the number of planning and progress officers employed full time at head office and on site during the survey week. The total number in the 86 contractors taking part in the survey came to 503, of which just over one-half (245) were employed at head office.

Table A.25 Numbers of planning officers by type of employer

		No. of planning and progress officers			
	No. of companies	At head office	At all sites	At large sites	Total
Major oil and chemical contractors	17	51	62	45	113
Constructional steelwork and gen. eng.	20	39	18	14	57
Electrical eng. and cables	22	86	72	61	158
Instrumentation	4	6	1	1	7
Boiler erection	4	27	35	30	62
Tank erection, pipework etc	14	19	58	39	77
Heating and ventilating etc	5	17	12	12	29
All companies	86	245	258	202	503

A.96 Bearing in mind the small number of boiler erection contractors in the survey, they were employing a high proportion of the total planning and progress officers, particularly at site level.

Site managers/agents; general foreman/supervisors

A.97 The numbers of site managers/agents and general foremen/supervisors employed by the survey contractors, and their ratio to employees on all sites and large sites, are shown in Table A.26.

Table A.26 Ratios of supervisors to operatives

All sites			Large sites		
Site managers/ agents	Employees	Ratio	Site managers/ agents	Employees	Ratio
753	26890	1:36	357	16563	1:46
Gen. foreman/ supervisors	Employees	Ratio	Gen. foreman/ supervisors	Employees	Ratio
2303	26890	1:12	1220	16563	1:14

The causes of delay

A.98 Contractors were asked to indicate from a list of possible reasons, the four which they regarded as the most important for delays in completing contracts for industrial construction work in recent years. They were also asked to rank the four chosen reasons in order of importance from 1 to 4.

A.99 Table A.27 shows that in their eyes at least, the contractors in the industry saw late design changes and late delivery of materials or plant as the major causes of delay. In fact 27 per cent of the total contractors ranked late design changes first, and a further 21 per cent ranked late deliveries first. This emphasis is striking, even allowing for the fact that some contractors would be unwilling to parade their own shortcomings in answer to this question, and that clients would probably have given a somewhat different picture.

Table A.27 Attributed causes of delay

Reason for delay	Average score*	Percentage of companies ranking as first
Late delivery of materials or plant	2·09	21
Late design changes	2·01	27
Unexpectedly low labour productivity	1·40	10
Other reasons	1·03	17
Labour disputes	1·02	8
Delays in subcontractors' performance	0·92	8
Skilled labour shortages	0·71	5
Faulty materials	0·28	1
Management problems more difficult than anticipated	0·21	1
Faulty workmanship	0·14	1
Other labour shortages	0·10	—

*By scoring 4, 3, 2, 1, 0 according to rank order.

A.100 Apart from 'Other reasons' (bad weather, late handover of work, access problems) unexpectedly low labour productivity was next in importance as a cause of delay. Labour disputes were frequently mentioned, notably among the more specialist engineering companies, but were generally not regarded as a paramount cause of delay, and were ranked first by only 8 per cent of the total contractors.

A.101 The major oil and chemical plant contractors together with the boiler-makers seem to be particularly handicapped by the problem of late deliveries and unexpectedly low labour productivity. As for the smaller specialist contractors, their reasons for delay were generally in line with the overall assessment, though problems of site access and main contractors' delays were frequently mentioned.

Earnings and hours of work

A.102 Part of the site questionnaire was designed to establish information on the earnings and hours of work of workers in different skill groups employed on large sites during the survey week. The earnings survey covered nearly 17,000 operatives on over 40 large sites.

Levels of earnings

A.103 Table A.28 shows the average weekly earnings of the main skill groups covered by the survey according to type of site. The total earnings figures include radius and lodging allowances and taxable travelling allowances. The welders had on average the highest total weekly earnings on all types of site, followed by the erectors/riggers. The electricians and insulators had the lowest. All skill groups, including the semi-skilled and the labourers, were on average earning more on CEGB power station sites than on oil and chemical plant sites. As shown later, this is mainly because bonus payments are not only more likely on CEGB sites but they also tend to be higher than elsewhere.

Table A. 28 Average weekly earnings by skill group and type of site

Size of sample (no. of operatives)	Skill group	Average basic earnings, £	Average total weekly earnings, £				
				Power stations			
		All sites	All sites	CEGB conv.	CEGB nuclear	SSEB	Oil and chemical
1924	Pipefitters	21·3	37·0	37·5	*	*	36·6
1299	Fitters/millwrights	18·2	37·8	38·2	37·1	(36·5)	37·2
1699	Welders	21·5	44·2	46·7	(48·9)	(52·6)	41·9
561	Platers/boilermakers	20·5	37·3	(41·3)	(39·9)	*	36·2
1738	Electricians	20·6	36·0	35·9	42·5	34·5	34·2
2227	Erectors/riggers	18·7	39·4	41·3	41·5	(44·6)	36·9
535	Scaffolders	19·1	38·0	40·9	*	*	35·5
255	Insulators	15·0	33·6	(40·2)	*	nil	29·9
3291	Semi-skilled (inc. mates)	15·9	31·3	33·0	31·6	28·1	29·6
1793	Labourers	15·1	27·0	28·2	24·7	(23·7)	25·7

( ) denotes sample under 100.
*denotes sample under 25.

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Earnings by type of contractor

A.104 Not surprisingly, therefore, those companies largely engaged on power station site work were paying their employees on average higher earnings than contractors working on other sites. Thus Table A.29 shows the average weekly earnings of welders and erectors/riggers employed by the boilermakers were some 19 per cent and 15 per cent higher respectively, than those paid to the same skill groups by the major oil and chemical plant contractors. The earnings of semi-skilled workers and unskilled labourers were also a good deal less among the major oil and chemical plant contractors than amongst the other contractors in the industry.

Table A.29 Average total weekly earnings by skill group and type of contractor, £

	Type of contractor						
Skill group	Major oil and chemical plant contractors	Constructional steelwork and general engineering	Electrical engineers (inc. turbines) and cabling	Instrumentation engineers	Boilermakers	Tank erection, pumps and pipework etc	Heating and ventilating, insulating, painting
Pipefitters	35·6	*	30·9	(47·2)	(45·9)	39·4	nil
Fitters/millwrights	32·8	(40·2)	34·4	*	43·5	(42·6)	nil
Welders	40·0	(47·8)	*	*	47·5	49·3	nil
Platers/boilermakers	35·8	(41·3)	nil	nil	(39·3)	(47·1)	nil
Electricians	35·0	*	35·0	(40·6)	(50·0)	(34·8)	38·5
Erectors/riggers	35·0	43·3	(37·2)	*	40·3	41·7	nil
Scaffolders	31·7	45·8	*	*	44·6	(32·5)	*
Insulators	(23·2)	nil	nil	nil	nil	nil	35·8
Semi-skilled (inc. mates)	28·6	33·8	27·5	(32·5)	39·7	33·0	24·4
Labourers	23·4	(29·0)	24·0	*	30·2	34·0	28·1

( ) denotes sample under 100.
*denotes sample under 25.

Composition of earnings

A.105 Table A.30 sets out the main components of average weekly earnings (including allowances) and expresses them as percentages of the total for each skill group in the survey pay week. For comparison purposes, the table covers CEGB conventional power station sites, oil and chemical plant sites, and all sites.

A.106 This table, together with Table A.28, outlines clearly the wide disparity between basic pay and total weekly earnings for all groups of workers on large sites. Taking large sites as a whole, basic pay did not exceed 60 per cent of total weekly earnings among any of the groups of workers covered by the survey. When CEGB sites are analysed alone, the proportion represented by basic earnings is even lower. Only amongst the electricians did the basic rate exceed one-half of total weekly earnings. In the case of welders it was only 39 per cent. On the oil and chemical plant sites basic pay was a relatively larger component (usually about 60 per cent) of total earnings compared with other sites. This must reflect to some extent the site agreements that are at present operating on these sites.

A.107 On top of basic earnings there were overtime payments, bonuses, radius, lodging and taxable travelling allowances, and small amounts of other payments,

Table A.30 Large sites: components of average weekly earnings, May 1969

		CEGB conventional						Oil and chemical						All sites					
		Basic	Over-time	Bonus	Allow-ances*	Other	Total	Basic	Over-time	Bonus	Allow-ances*	Other	Total	Basic	Over-time	Bonus	Allow-ances*	Other	Total
Pipefitters	£	18·0	5·7	7·1	5·1	1·6	37·6	22·0	6·1	2·8	2·6	3·1	36·6	21·3	6·1	3·7	3·1	2·8	37·0
	%	48	15	19	14	4	100	60	17	8	7	8	100	58	16	10	8	8	100
Fitters/millwrights	£	17·9	6·2	7·6	4·6	1·8	38·2	19·2	8·2	5·4	3·0	1·3	37·2	18·2	7·2	6·5	4·2	1·6	37·8
	%	47	16	20	12	5	100	52	22	15	8	3	100	48	19	17	11	4	100
Welders	£	18·1	6·4	11·8	4·9	5·5	46·7	23·9	7·7	4·8	3·1	2·5	41·9	21·5	7·1	8·2	4·0	3·3	44·2
	%	39	14	25	10	12	100	57	18	11	7	6	100	49	16	19	9	7	100
Platers/boilermakers	£	(16·8)	4·7	14·2	3·4	2·2	41·3	21·4	7·5	3·1	1·0	3·2	36·2	20·5	6·9	5·3	1·7	2·9	37·3
	%	(41)	11	34	8	5	100	59	21	9	3	9	100	55	18	14	5	8	100
Electricians	£	20·7	9·2	0·6	5·1	0·3	35·9	20·5	5·7	3·6	3·3	1·3	34·2	20·6	8·8	1·4	4·8	0·4	36·0
	%	58	26	2	14	1	100	60	17	10	10	4	100	57	24	4	13	1	100
Erectors/riggers	£	17·3	5·5	11·6	4·4	2·6	41·3	21·3	6·1	4·6	2·6	2·4	36·9	18·7	6·2	8·5	3·7	2·3	39·4
	%	42	13	28	11	6	100	58	17	12	9	5	100	47	16	22	9	6	100
Scaffolders	£	16·6	6·7	10·3	5·1	2·2	40·9	21·7	4·8	3·9	1·9	3·3	35·5	19·1	5·8	6·9	3·5	2·7	38·0
	%	41	16	25	13	5	100	61	14	11	5	9	100	50	15	18	9	7	100
Insulators	£	(14·7)	11·1	8·2	6·1	0·2	40·2	15·0	7·1	4·0	3·5	0·4	29·9	15·0	8·6	5·3	4·4	0·3	33·6
	%	(37)	28	20	15	1	100	50	24	13	12	1	100	45	26	16	13	1	100
Semi-skilled	£	15·7	6·9	5·5	3·7	1·1	33·0	16·5	6·3	2·8	1·9	2·1	29·6	15·9	7·0	4·1	2·9	1·5	31·3
	%	48	21	17	11	3	100	56	21	9	6	7	100	51	22	13	9	5	100
Labourers	£	15·2	3·5	4·5	2·6	2·3	28·2	15·1	4·8	2·6	2·0	1·2	25·7	15·1	4·2	3·6	2·3	1·7	27·0
	%	54	12	16	9	8	100	59	19	10	8	5	100	56	16	13	9	6	100

( ) sample under 100 operatives.
*radius, lodging and travelling (taxable) allowances.

though it should be remembered that some workers included in the overall averages would not necessarily be receiving payment for any of these reasons. In general, overtime pay represented a higher proportion of total earnings on oil and chemical plant sites than on CEGB power station sites, but the opposite was true with regard to the bonus.

As Table A.30 shows bonus earnings are often twice as high in amount on CEGB sites for the same occupational groups in comparison with the oil and chemical plant sites. Among the skill groups, the proportion of total earnings paid in bonus was highest for the platers/boilermakers (34 per cent) and the erectors/riggers (28 per cent). These proportions would obviously be much higher among some individual workers on bonus, as non-bonus earners have also been included in deriving the overall averages. In comparison, the fitters/millwrights (15 per cent) were earning the highest average bonuses on the oil and chemical plant sites.

A.108 Radius, lodging and taxable travelling allowances for most skill groups averaged about £5 a week on CEGB sites, and somewhat less on the oil and chemical plant sites, presumably because the latter were in less remote areas and depended more on local labour.

Range of weekly earnings

A.109 The figures of average earnings in Tables A.28 to A.30 conceal differences in the range of average earnings within each skill group. Table A.31 shows that of all the skill groups, welders had the highest proportion—27 per cent—of the workers on sites where their average earnings exceeded £50 per week. Erectors/riggers, too, had a relatively high proportion in the same category, but at the same time a much more marked range of earnings.

Table A.31 Distribution of earnings

Proportion of operatives on sites where average earnings were:

	Less than £25	£25–40	£40–50	Over £50
	%	%	%	%
Pipefitters	(2)	77	17	(3)
Fitters/millwrights	(4)	57	31	8
Welders	neg	48	25	27
Platers/boilermakers	(3)	74	(15)	(8)
Plumbers	(7)	67	(25)	(1)
Insulators	(18)	64	(16)	(2)
Erectors/riggers	7	45	31	16
Electricians	4	73	20	(3)
Semi-skilled	20	68	11	neg
Unskilled	43	44	13	none

( ) denotes sample under 100 operatives.

Overtime

A.110 The survey showed that in general mechanical and electrical engineering workers on large sites worked long hours and lengthy overtime seemed to be demanded by both employers and operatives. (There were, of course, some workers who worked no overtime at all, but the averaging of the figures would conceal them.) No skill group on any of the main types of site was working on average less than about 6 hours of overtime each week, and the average for many skill groups was well over 10 hours per week. The average on CEGB nuclear power station sites for electricians was over 18 hours. There was indeed evidence in the survey that overtime hours in some companies seem to be excessive. For example, Table A.34 shows that on this power station site there were groups of workers (albeit small) who were working an average nearly 30 hours a week overtime; and, similar high overtime levels were found on other power station sites (Tables A.35 and A.36).

A.111 The prospects of high overtime earnings are an obvious incentive to get the travellers in the industry on to particularly isolated sites, and this probably explains why overtime earnings are so high on the CEGB nuclear power station sites (Table A.32). It was not possible from the survey results to differentiate between ordinary weekday overtime and that at weekends.

Table A.32 Average overtime (hours per week) worked by skill group and type of site (on approx 40 hours basic)

	Power stations			
Skill group	CEGB conv.	CEGB nuclear	SSEB	Oil and chemical
Pipefitters	10·1	*	(8·0)	7.8
Fitters/millwrights	9·7	16·7	(10·3)	10·9
Welders	9·8	(9·2)	(12·1)	9·4
Platers/boilermakers	(6·8)	(7·1)	*	9·8
Electricians	11·0	18·6	10·7	7·2
Erectors/riggers	7·9	11·9	(10·4)	8·1
Scaffolders	11·0	*	*	8·3
Insulators	(16·5)	*	nil	10·7
Semi-skilled (inc. mates)	11·8	20·6	11·0	10·7
Labourers	5·9	8·4	(10·0)	9·9

( ) denotes sample under 100.
*denotes sample under 25.

Bonus earnings

A.112 Taking bonus earnings in the industry as a whole, the survey showed that in terms of actual cash for the pay week, they were on average highest among erectors/riggers (£8·5) and welders (£8·2).

A.113 As Table A.33 shows, the boilermakers and the constructional steelwork and general engineering contractors were much more likely to be operating company bonus schemes than other companies in the industry. Virtually all the craft employees (even the electricians) employed on sites by the boilermakers were getting bonus earnings. The major oil and chemical plant contractors, on the other hand, were much less likely to be operating such schemes, and there were a fair number of site returns from these contractors—usually about a quarter for each skill group—which showed that skilled workers were not being paid a bonus.

A.114 The survey also asked contractors to distinguish between incentive bonus payments, and other bonus payments such as lieu bonuses, productivity payments and other similar payments. The results showed that for most companies bonuses were based on direct incentive schemes, apart from the electrical engineering contractors who, as would be expected, were more likely to use indirect bonuses if they were operating a bonus scheme.

Table A.33 Proportion of site returns on which bonus is being paid by type of contractor, %

	Major oil and chemical plant contractors	Constructional steelwork and general engineering	Electrical engineering	Boiler-makers	Tank erection, pipework etc	Heating and ven-tilating etc	All companies
Pipefitters	71·4	100·0	60·0	100·0	83·9	—	74·7
Fitters/millwrights	64·7	83·3	71·8	100·0	44·4	—	72·6
Welders	77·8	92·0	63·6	100·0	77·1	—	82·0
Platers/boilermakers	71·4	91·7	—	100·0	55·6	—	80·9
Erectors/riggers	80·0	85·7	66·7	95·0	83·3	—	81·3
Scaffolders	44·4	88·9	28·6	93·3	94·7	100·0	76·9
Electricians	58·8	87·5	20·9	92·9	100·0	—	46·2
Semi-skilled	63·6	72·0	43·1	100·0	78·1	52·4	60·3
Labourers	76·2	83·3	36·1	50·0	50·0	41·7	52·2

Table A.34 CEGB power station site 'A', weekly earnings by company and skill

Company		Pipefitters	Fitters	Welders	Platers	Erectors	Electricians
1	No. of operatives					52	
	Overtime hrs					7·5	
	Earnings £					55·8	
2	No. of operatives		3	3		2	
	Overtime hrs		28	28		25	
	Earnings £		43·3	44·7		36·0	
3	No. of operatives		3				
	Overtime hrs		11·3				
	Earnings £		33·0				
4	No of operatives			5		8	
	Overtime hrs			25		19	
	Earnings £			57·0		45·0	
5	No. of operatives						20
	Overtime hrs						1
	Earnings £						34·0
6	No. of operatives						70
	Overtime hrs						0·3
	Earnings £						41·1
7	No. of operatives	10	21				3
	Overtime hrs	5·0	5·0				5·0
	Earnings £	34·5	34·6				35·0
8	No. of operatives		3				
	Overtime hrs		19·3				
	Earnings £		40·0				
9	No. of operatives	7					
	Overtime hrs	9·3					
	Earnings £	37·4					
10	No. of operatives		33	34	11	58	
	Overtime hrs		14·2	8·1	5·5	9·1	
	Earnings £		56·3	59·8	43·7	58·4	
11	No. of operatives	5				5	
	Overtime hrs	9·6				9·6	
	Earnings £	35·4				35·4	
12	No. of operatives		3				
	Overtime hrs		24·3				
	Earnings £		36·7				
13	No. of operatives	17		10		8	
	Overtime hrs	8·5		8·0		1·8	
	Earnings £	49·6		59·1		36·4	
14	No. of operatives						70
	Overtime hrs						18·0
	Earnings £						41·1

Variations in earnings on site

A.115 The survey provided statistics showing the extent to which average weekly earnings differed between companies for the same skill groups on the same site. Total earnings will, of course, be dependent on bonus and overtime earnings and lodging allowances etc, so some company differences would be expected. However, Tables A.34 to A.39 do point to the fact that there are some awkward anomalies which would call for some explanation and which could easily lead to a sense of grievance among workers on site. On the three CEGB sites in particular, there are wide differences in total earnings for the same skill of workers on each site employed by different companies. For example, Table A.34 shows some pipefitters were earning for the week about £35, while others in another company nearly £50. And in Table A.36 the earnings of welders ranged from £36 in one company to over £65 in another. As previously mentioned, differences in bonus or overtime payments are the explanation in many of the cases, but by no means all.

A.116 On the whole, the disparity of earnings between companies for the same skills was less on the oil and chemical plant sites. This is particularly noticeable in Table A.39 where a fairly rigid site agreement has been operating at the site.

Table A.35 CEGB power station site 'B', weekly earnings by company and skill

Company		Pipefitters	Fitters	Welders	Platers	Erectors	Electricians
1	No. of operatives			4		90	
	Overtime hrs			5·8		7·1	
	Earnings £			39·0		39·6	
2	No. of operatives		4				
	Overtime hrs		5·0				
	Earnings £		32·3				
3	No. of operatives		15	10		19	
	Overtime hrs		22·0	20·0		19·0	
	Earnings £		47·0	52·0		40·0	
4	No. of operatives						19
	Overtime hrs						11·2
	Earnings £						30·0
5	No. of operatives		6				
	Overtime hrs		8·0				
	Earnings £		32·0				
6	No. of operatives		3				
	Overtime hrs		26·3				
	Earnings £		37·7				
7	No. of operatives	7	54				4
	Overtime hrs	6·0	6·0				6·0
	Earnings £	34·3	34·2				34·3
8	No. of operatives	16					7
	Overtime hrs	20·8					18·4
	Earnings £	52·0					45·6
9	No. of operatives		47	15	16	48	
	Overtime hrs		10·4	10·9	12·6	10·3	
	Earnings £		51·1	57·5	53·5	54·4	
10	No. of operatives	17		20		27	
	Overtime hrs	10·6		11·6		10·7	
	Earnings £	46·2		60·0		47·3	
11	No. of operatives	5				5	
	Overtime hrs	1·6				1·6	
	Earnings £	31·2				31·2	

Table **A.36** CEGB power station site 'C', weekly earnings by company and skill

Company		Pipefitters	Fitters	Welders	Platers	Erectors	Electricians
1	No. of operatives						26
	Overtime hrs						18·7
	Earnings £						32·7
2	No. of operatives						58
	Overtime hrs						8·0
	Earnings £						28·8
3	No. of operatives	6	3				9
	Overtime hrs	9·0	13·7				15·2
	Earnings £	24·7	35·7				40·8
4	No. of operatives	2		2			
	Overtime hrs	14·5		14·5			
	Earnings £	40·5		43·5			
5	No. of operatives	10		5		10	
	Overtime hrs	21·2		37·8		21·2	
	Earnings £	40·2		57·4		40·2	
6	No. of operatives		8				
	Overtime hrs		18·4				
	Earnings £		33·3				
7	No. of operatives	10		6	9		
	Overtime hrs	13·5		20·0	16·4		
	Earnings £	53·1		65·2	58·9		
8	No. of operatives		5				
	Overtime hrs		7·2				
	Earnings £		31·0				
9	No. of operatives		37			11	
	Overtime hrs		10·4			15·2	
	Earnings £		32·9			38·2	
10	No. of operatives		32	105	10	130	6
	Overtime hrs		—	—	—	—	13·0
	Earnings £		22·3	36·0	25·4	20·7	42·5

Table A.37 Oil and chemical plant site 'A', weekly earnings by company and skill

Company		Pipefitters	Fitters	Welders	Platers	Erectors	Electricians
1	No. of operatives	42	5	23		16	
	Overtime hrs	—	—	—		—	
	Earnings £	32·9	35·6	33·8		35·1	
2	No. of operatives			3		3	
	Overtime hrs			—		—	
	Earnings £			26·0		26·0	
3	No. of operatives						27
	Overtime hrs						6·3
	Earnings £						30·0
4	No. of operatives		3	4		8	
	Overtime hrs		0	0		0	
	Earnings £		38·0	40·0		38·3	
5	No. of operatives	17		11		9	
	Overtime hrs	1·2		17·6		19·2	
	Earnings £	45·0		54·5		42·9	
6	No. of operatives	70		5			5
	Overtime hrs	0		0			0
	Earnings £	34·4		36·4			36·4
7	No. of operatives	115	14	33		17	2
	Overtime hrs	—	—	—		—	—
	Earnings £	35·5	35·5	33·2		34·8	35·2

Table A.38 Oil and chemical plant site 'B', weekly earnings by company and skill

Company		Pipefitters	Fitters	Welders	Platers	Erectors	Electricians
1	No. of operatives		94	55	95	87	57
	Overtime hrs		8·0	8·0	8·0	8·0	8·0
	Earnings £		28·0	29·9	29·9	26·5	30·3
2	No. of operatives			3			
	Overtime hrs			21·0			
	Earnings £			46·0			
3	No. of operatives					6	
	Overtime hrs					26·5	
	Earnings £					57·3	
4	No. of operatives		6				
	Overtime hrs		34·2				
	Earnings £		45·2				
5	No. of operatives						6
	Overtime hrs						11·5
	Earnings £						28·8
6	No. of operatives			4			
	Overtime hrs			13.3			
	Earnings £			44·0			
7	No. of operatives		5	8	19	5	
	Overtime hrs		12·0	12·0	12·0	12·0	
	Earnings £		43·0	47·0	43·0	43·0	
8	No. of operatives	43	5	22	16	12	
	Overtime hrs	13·0	13·0	12·9	17·2	16·1	
	Earnings £	38·6	35·8	41·0	41·5	36·4	

Table A.39 Oil and chemical plant site 'C', weekly earnings by company and skill

Company		Pipefitters	Fitters	Welders	Platers	Erectors	Electricians
1	No. of operatives	70	13	26	14	44	47
	Overtime hrs	0	0	0	0	0	0
	Earnings £	30·0	28·9	32·3	29·8	29·3	31·9
2	No. of operatives	17	2	4	4	24	5
	Overtime hrs	0	0	0	0	0	0
	Earnings £	32·1	30·5	37·3	31·8	31·2	35·6
3	No. of operatives	103	5	78	3	47	
	Overtime hrs	0	0	0	0	0	
	Earnings £	30·5	30·4	33·0	29·0	32·2	
4	No. of operatives	9	2	3			2
	Overtime hrs	0	0	0			0
	Earnings £	29·9	29·0	32·3			30·0
5	No. of operatives	15	5	14	2	29	8
	Overtime hrs	10·9	6·6	10·6	11·5	11·6	25·5
	Earnings £	48·1	43·0	52·4	42·0	52·4	58·8
6	No. of operatives						11
	Overtime hrs						10·5
	Earnings £						31·3
7	No. of operatives	9		8		6	
	Overtime hrs	0		7·8		0	
	Earnings £	36·8		45·9		37·5	

Annex *NEDO list of large industrial construction sites at the time of the survey (May 1969)*

CEGB conventional power stations
Ratcliffe, Notts
Didcot, Berks
Drax, Yorks
Cottam, Notts
Kingsnorth, Kent
Fiddlers Ferry, Lancs
Pembroke
Rugeley, 'B', Staffs
Fawley, Hants
Aberthaw 'B', Glam
Tilbury, 'B', Essex
Ironbridge 'B', Salop

CEGB nuclear power stations
Dungeness 'B', Kent
Hinkley Point 'B', Somerset
Wylfa, Anglesey
Hartlepool, Durham

UK Atomic Energy Authority
Dounreay, Caithness

SSEB power stations
Cockenzie, E. Lothian
Longannet, Fife
Hunterston, Ayr

Steel works sites
Port Talbot, Glam
Lackenby, Teesside

Gas plant sites
Bacton, Norfolk
Liverpool (Linacre works)
Croydon, Surrey
East Greenwich
Plymouth
Blaydon, Durham

Oil refinery and chemical plant sites
Killingholme (Lindsay), Lincs
Killingholme (Continental), Lincs
Teesport, Durham
Ellesmere Port, Cheshire
Coryton, Essex
Milford Haven, Pembroke
Grangemouth (BP Chemicals), Stirling
Grangemouth (ICI), Stirling
Wilton, Teesside
North Tees (ICI), Durham
Hillhouse, Lancs
Runcorn, Cheshire
Stanlow, Cheshire
Ince Marshes, Cheshire
Baglan Bay, Glam
Seal Sands, (Monsanto) Durham
Fawley, Hants
Ardeer, Ayr
Carrington, Cheshire
Isle of Grain, Kent
Shellhaven, Essex
Avonmouth, Bristol

Non-ferrous metals plant sites
Anglesey
Lynemouth, Northumberland
Invergordon, Ross & Cromarty
Staithes, Yorks
Clydach, Glam

Appendix 3 Reports by the Department of Employment and Productivity

A.117 As part of its contribution to the work of the Working Party, the Department of Employment and Productivity (DEP) produced two reports which are reproduced as Part 1 and Part 2 of this appendix. Part 1 is based upon the views and findings of the DEP's regional manpower advisers on the reasons for disputes on large sites. Part 2 is a statistical analysis of stoppages of work on large sites during the period 1964–68.

Part 1 Findings of regional manpower advisers

Introduction A.118 For some years, the DEP has been concerned about the high level of industrial disputes on large construction sites. These disputes have been one factor (though, in the DEP's view, probably not the main factor) causing delays in the commissioning of extremely expensive new plant such as power stations and oil refineries. Because of the serious economic considerations involved, large sites have been given a relatively high priority in advisory work both by the former Ministry of Labour Industrial Relations Service and by the DEP's Manpower and Productivity Service which took its place in the summer of 1968. In each region, a manpower adviser has been designated as taking a special interest in large industrial sites in his region, from the pre-planning stage onwards.

A.119 The DEP welcomed the establishment of the NEDC Working Party because it was clear that the high level of disputes in this sector was only a symptom of much deeper managerial, organisational and industrial relations problems which merited overall examination in depth by all the parties concerned.

A.120 The DEP also collected statistics of stoppages on large industrial construction sites between 1964 and 1968, and these are given in Part 2 of this appendix.

A.121 Part 1 is based on reports from manpower advisers (or industrial relations officers) on their visits to large sites in recent years. In some cases, manpower advisers have carried out extended surveys over a period of time, involving a wide range of discussions with clients, contractors and trade unions; in other cases, contact with sites has been more intermittent. On the whole, manpower advisers have had closer contact with power station sites than with oil refinery and chemical plant sites. While it could not be claimed that any of this material has the status of fully-fledged research data, it may be of some value to the Working Party as representing the objective findings of officers experienced in industrial relations who have been following developments at individual sites over a period of years. Although in many cases, these findings corroborate points which the Working Party itself makes, the illustrations set out here may be useful.

A.122 Brief details of one admittedly extreme example of a troubled site are given at the end of this section (§ A.167–A.170).

A.123 The remainder of Part 1 sums up some of the conclusions reached by manpower advisers as a result of their advisory work and illustrates the points made.

Multiplicity of contractors

A.124 *Multiplicity of contractors and subcontractors is a major source of managerial and industrial relations problems. Where it is necessary to have more than one main contractor, either the client or one particular main contractor needs to take responsibility for co-ordinating industrial relations policy. Special problems may arise through the lack of a central authority where a consortium is operating.*

A.125 On the industrial relations side, multiplicity of contractors leads to differences in working methods, hours, pay and industrial relations procedures. Co-ordination is often resisted by individual companies who favour their own procedures. While some difficulties are due to discrepancies between the different national agreements operated on large sites, other difficulties arise through differing practices as between contractors nominally observing the same national agreement. The lack of uniformity in pay and conditions inevitably causes tension between different groups of workers.

A.126 On one project the employees of a particular main contractor finished at 4.30pm, because 'they wanted to' whereas all other workers finished at 6pm as required by the employers. In the case of the same contractor pay questions were determined at the company's headquarters away from the site, whereas in the case of the other firms operating on the site pay was a matter dealt with locally. One main contractor operating on oil refinery sites deliberately reduced the extent to which work was subcontracted in order to ensure greater control over the work. On an earlier project this contractor had subcontracted almost all the work whereas on a later project they did most of it themselves. They found the latter arrangement much more satisfactory in terms of control and said they would not revert to subcontracting on the same scale again.

A.127 Demarcation disputes may also arise from a very large number of subcontractors on the site who are often unaware of local trade union agreements and practices. In an attempt to improve the situation, one client now ensures that these contractors reach agreement with local union officials before awarding them the contract.

A.128 Another kind of difficulty was associated with consortia. On one project friction occurred between the numerous members of the consortium who were unwilling to surrender any part of their independence to the group. There were no general or sectional site agreements. The labour relations officer appointed by the group had considerable difficulty in establishing himself at all as an effective force on site. Despite this, he succeeded in achieving considerable progress in improving industrial relations.

The need for greater management expertise in handling industrial relations

A.129 *Many of the industrial relations problems which have arisen could have been avoided if management were better trained and equipped to deal with industrial relations and personnel problems and if they had personnel specialists to assist them.*

A.130 Because of the complex technical content of large site work, contractors' site agents tend to be engineers first and foremost and may have little experience and training in industrial relations. One such resident engineer was described as: 'A dyed-in-the-wool technical man whose sole preoccupation was with technical matters, who knew nothing about industrial relations and cared less.'

Possibly because of lack of confidence in the ability of site agents to deal with industrial relations, some firms give their agents too little discretion on labour matters, and by requiring reference to headquarters on minor matters, cause delays in settling grievances.

A.131 The DEP has been encouraged to note some action by employers to improve the situation. Employers' associations have organised conferences for discussion of industrial relations problems, and have had discussions with training boards on the development of management training. On some sites, training for senior management has been organised by the Industrial Society, while on other sites arrangements have been made for supervisors to attend 'Training within Industry' courses.

A.132 The Phelps Brown Committee recommended the appointment of more trained personnel specialists to occupy senior positions in large building and civil engineering firms. In addition, the committee suggested that 'On very large sites where several hundred men are employed, there is a strong case for the appointment of a personnel specialist to assist the site agent in dealing with incentive bonuses, work study, relationships with unions, recruitment, discharge and transfer of labour and welfare questions. Often the site agent will be preoccupied with technical problems and day to day crises and unable to give adequate attention to labour problems.' These recommendations seem highly relevant to firms engaged in mechanical work on large sites. In certain cases the DEP has been able to assist in finding suitable site labour officers.

Pre-planning and co-ordination of industrial relations

A.133 *It is essential to pre-plan industrial relations and labour policies both as between client and contractors and with full time union officials: it is no less necessary to communicate effectively any agreements that have been reached to workers joining the site. There has been little evidence in the past, with one or two notable exceptions, of positive attempts to develop joint consultation on site. More generally, there appear to be serious problems of communications between all parties on sites.*

A.134 The complexity of labour problems on large sites and the dangers arising from discrepancies between the pay and conditions of different groups of workers make the pre-planning and co-ordination of industrial relations essential. Where there is more than one main contractor, the client may alone have sufficient authority to act as co-ordinator, though possible alternatives are for one main contractor to be recognised by the others as performing a co-ordinating role or for an employers' association (to which all the main contractors belong) to act as co-ordinator.

A.135 On some oil refinery and chemical plant sites, the client has played a central role in the co-ordination of labour relations. One chemical plant client, for instance, kept his contractors on an unusually tight rein and experienced very little trouble on site and no delays in completion of contracts.

A.136 In other cases, the initiative rested with one main contractor. For instance, on an oil project, there was a site agreement between the main contractor and the mechanical unions, affecting mechanical construction workers only. It established a comprehensive rate with annual increases during the course of construction. Procedure was provided for an employee to appeal against dismissal. There was also provision for marginal flexibility between crafts and for all lines of demarcation to be removed and all restrictive practices and customs to be banned, although this did not work as well as the employer hoped. The contractors tended to give in when strongly pressed by a union on the right of its members to do a particular job. The site agreement at this project was considered to be very much the core of industrial relations and represented a very positive channel of communications between employers and employees. The agreement, although not entirely successful in achieving all its intentions, seemed to serve a very valuable purpose.

A.137 On power station sites, the CEGB has not in general played a key role in the co-ordination of industrial relations. None the less, our officers have noted that on certain sites the positive attitude taken by the CEGB site engineer has made a major contribution to maintaining harmonious relationships and keeping down the number of disputes. However, these sites have been the exception rather than the rule and co-ordination on power station sites has frequently been a major problem. On one site, a code of practice and points for guidance had been agreed between contractors at the commencement of the project at the instigation of the local engineering employers' sites group, but this appeared to have had little effect. There was no established procedure for regular meetings of employers. It was merely agreed that ad hoc meetings would be called when special difficulties arose.

A.138 There has in the past been relatively little positive use of *joint consultation* machinery as a means of avoiding potential industrial relations difficulties and involving workers in the progress of the project. Comprehensive site-wide consultative machinery appears to have been virtually non-existent. Most contractors seem to have taken the view that joint consultation could not be made to work in terms of any useful formal machinery covering sites as a whole, presumably because of the multiplicity of national agreements involved. Some contractors have had constructive monthly meetings with union representatives but this was unusual. On many sites, joint consultation took place between management and shop stewards and union officials but it appeared that this was done of necessity to deal with disputes when they arose rather than on any positive basis. On one site, it was noted that disputes were so frequent that management and shop stewards were virtually in continuous session.

A.139 Consultation often seemed to be lacking even on such matters as safety or canteen facilities. On one site throughout the course of the manpower adviser's investigations, there were no workers' representatives on the site safety committee in spite of requests by unions to take part. On another site there were no site safety committees. On occasion, union pressures for a site committee were strongly resisted. One engineering company in fact made it an offence for its shop stewards to have any official contact with the stewards of other contractors on the site, presumably supposing that by this means connivance on wage questions would be avoided.

A.140 Quite apart from formal joint consultation, there are obviously major problems of *communications* on these sites at all levels—between client, contractors, subcontractors and employees. On a number of sites where serious disputes occurred there was little evidence to show that the problems of achieving effective communication had been seriously tackled by the contractors concerned. Equally, channels of communication between full time officials, shop stewards and members were often weak. Frequently full time officials were not available when required and sometimes they seemed to have little or no influence over their own shop stewards. In extreme cases communications were poor, undesirable bargaining techniques were employed and a general lack of confidence existed on both sides. Any improvement in this situation could only be achieved by imaginative action by contractors and unions and by patient and sustained effort; on some more recent sites, efforts of this kind are being made.

A.141 On one oil refinery site, it was found that management and employees including some of the shop stewards were unaware of the terms of the site agreement and it was considered that this together with a general failure in communications on both management and trade union sides was the fundamental cause of much of the trouble on this site.

Disputes procedures

A.142 *Official disputes procedures have been criticised in some cases as being too remote and too slow. Inadequate authority is sometimes delegated to site managers to deal quickly with minor complaints.*

A.143 Disputes procedures are laid down both in national agreements and in certain site agreements. The site engineer on one large project considered that the procedure laid down in a national agreement had a stabilising effect and took some of the heat out of a situation. Others were more critical of existing national disputes procedures and regarded them as too remote and slow. Settlements could take several months to obtain. Comparison was drawn in two cases to the speed with which the civil engineering procedure could operate.

A.144 Many disputes on large contracts appeared to arise as a direct result of a number of relatively small and irritating complaints that seemed to take a long time to rectify, often because site managers had insufficient authority to deal with disputes without reference to their headquarters.

Discipline

A.145 *Both site management and official union leadership find it hard to exert discipline over work group pressures on site. Maladroit attempts to reassert discipline by some contractors have proved unsuccessful and made matters worse.*

A.146 There appeared to be a considerable difference in the degree of discipline operating from site to site. In some cases work group pressures had built up to a point where management could scarcely be said to be in charge at all. Attempts to restore discipline failed because management were unable or unwilling to stand up to resulting industrial action. On one exceptionally troubled power station site, local officials were less than helpful in finding solutions to disputes. Men would not take responsibility for fear of action by their mates. Consequently foremen refused to be transferred to this site and they asked to be sent to another job after a short period. General labourers refused to handle scaffold fittings in a clearing up process while scaffold labourers refused to 'de-nail' timber. General labourers also had a two-week strike because men were discharged for refusing to move round the site. While no doubt management has some responsibility for failure to assert control in the initial stages of this contract, even a model employer would have found serious difficulty in handling this contract.

A.147 On another project beset with considerable problems, no concerted disciplinary policy by employers could be discerned and disciplinary matters appeared to have been badly handled by some firms on the site. On this and a number of other sites, firms attempted to assert their authority by dismissals but were subsequently compelled to re-engage those dismissed. On one site, the pattern of disciplinary dismissal, strike action, reinstatement, occurred no less than thirteen times. Considerable improvement could have been brought about with better disciplinary procedures and greater official union control over the men.

A.148 A contrasting situation to that described in the previous paragraphs was found at an oil refinery site where it appeared that the main contractor had decided as a matter of policy to clamp down immediately on any action which was a breach of the site agreement. On two occasions, a trial of strength took place involving strike action and in each case the firm promptly sacked the strikers. This contractor had experienced a good deal of lost time on a previous project through men stopping work to attend unauthorised meetings through strikes over dismissals even though the site agreement provided for an appeals procedure. On the later project, the main contractor ensured that men were dismissed only when the circumstances justified it and this solved the problem.

Shop stewards

A.149 *Shops stewards require training.*

A.150 Shop stewards were blamed by some employers' representatives for much industrial unrest on site, although there was often no common approach on site to stewards except to try to prevent them from getting together as a group. Training arrangements for shop stewards generally tended to be poor. While trade union officials complained bitterly of managements' lack of understanding in industrial relations matters, they were often quite negative in their own approach to the training of shop stewards. Where turnover of shop stewards was high, real difficulty was found in building up good relationships between management and shop stewards.

A.151 Co-operation with stewards was achieved on some projects. The main contractor on one site found that there was difficulty in getting certain trade union officials to come down to the site when their presence was required. On a subsequent contract this contractor provided facilities for full time officials to meet shop stewards monthly. This ensured that full time officials were reasonably closely involved with the site and that no situation could be left to deteriorate indefinitely.

Recruitment and selection

A.152 *Recruitment and selection methods at all levels are often inadequate.* DEP *site offices may be able to help with recruitment and with both labour supply and redundancy problems.*

A.153 The Phelps Brown Committee considered that in building and civil engineering 'Much greater care should be taken in the recruitment and selection of workers' [para 20 (c)]. The experience of our manpower advisers suggests that the same could be said of many mechanical contractors on large industrial construction sites. Recruitment selection and induction of operatives have tended to be inadequate. More recently however some contractors have introduced more sophisticated techniques for informing new recruits of their pay and conditions and the terms of site agreements.

A.154 At some large sites the DEP has maintained its own employment office. These offices are useful not only for recruitment and liaison with the employment exchange network but as a link with other DEP services, such as manpower advisers. The site office could further play a valuable role in providing information to workers about jobs elsewhere when a rundown of labour occurs.

Continuity of employment

A.155 *Industrial relations difficulties were often associated with lack of continuity of employment; the scope for more extensive transfer procedures and more careful handling of redundancy procedures deserves examination.*

A.156 The Phelps Brown Report urged building and civil engineering firms to make greater efforts to transfer workers between sites and to introduce more systematic transfer procedures. The DEP supports this approach and believes there may be scope for it in large site engineering work; but it is clear that companies operating such policies need to take account of regional and local variations in the industrial relations situation and in union organisation.

A.157 On some sites there was no coherent redundancy policy and no co-ordination between contractors on possible redundancies. When a contract neared completion the more highly skilled tradesmen tended to leave or were transferred to other sites, and the remaining workers became unsettled, either because bonuses were reduced as the work tailed off or because the men feared redundancy. Disputes tended to increase, for instance on demarcation questions. On one site the union operated overtime bans whenever redundancies occurred.

Pay

A.158 *Pay questions, directly or indirectly, are the greatest source of disputes, particularly where apparently unjustifiable disparities in pay arise or difficulties arise in bonus schemes.*

A.159 The statistics of stoppages and the reports of our manpower advisers show that bonus payments were the most important single cause of disputes. Even some strikes attributed to disciplinary action originated in bonus disputes. Differences in bonus rates and fringe benefits paid by the numerous contractors and subcontractors on the same site are a natural breeding ground for disputes. On one project, there was little unrest during the earlier years, but in the later stages stoppages occurred involving thermal insulation engineers and electricians who were on a lower rate than that provided by the site agreement for mechanical trades.

A.160 Difficulties also arise because of discrepancies between sites. On one site, a dispute arose over the pay of welders who on other sites were in some cases getting more than twice the rate per hour on this site. News of disparities of this nature quickly spreads. One contracting firm which attempted to apply national average rates throughout their UK sites ran into considerable difficulties.

A.161 The site manager on a large oil refinery project thought that it was the existence of a comprehensive rate which made the greatest contribution to industrial peace on his site by largely removing day to day argument and bickering about money. No bonuses were paid on this site but it appeared that overtime earnings were being used to allow the men to achieve an acceptable earnings level.

A.162 Where bonuses were paid, attempts of various kinds were made to reduce the incidence of bonus disputes. On one site special efforts were made to ensure that bonus particulars were published early. At one stage of a gas plant project the level of earnings was a consistent cause of unrest and productivity fell as a result. This problem was solved by two shop stewards being sent to observe the operation of an identical bonus scheme to theirs existing at another of the company's sites. On return they held meetings with the workers and from then on productivity increased from the existing 70/80 performance to an average of 100. On a power station site a useful concept of performance investigation emerged in the course of the settlement of a bonus dispute. This involved a joint examination of any failure by gangs to achieve their bonus targets. The investigation was done with a considerable degree of frank objectivity on both sides. Although the process was time consuming, the contractors felt it entirely worth while, not only as a means of eliminating specific shortcomings whether on the part of management or gangs but also as a way of improving communications and involving workpeople in the progress of the work. This procedure apparently virtually eliminated strikes due to bonus.

A.163 One particular site study sums up much of the difficulty associated with bonus payments. Most management representatives on this site clearly thought that satisfactory output could only be achieved if wages were tied to output through bonus schemes, whereas most worker' representatives thought that site bonuses were much too vague and unfair. This difference in approach underlined the suspicions and complete lack of trust between management and men on this site. Despite the many and varied bonus schemes introduced, output was low in almost all cases. There appeared to be some truth in union allegations that management did not have the facilities or expertise to devise and administer fair bonus schemes.

Site amenities

A.164 *Site amenities can affect industrial relations substantially and are frequently the subject of complaints.*

A.165 There were complaints on earlier sites about unsatisfactory accommodation and inadequate recreational facilities; safety and first aid also came in for some criticism. On one site a delay in providing canteens and toilets affected industrial relations during the crucial early months of the contract. On another site at one stage men were being charged for hot water. In contrast at a power station site, the excellent welfare facilities, canteens, toilets, washrooms etc were thought to have contributed much to the good relations on this site.

A.166 Manpower advisers were critical of the system by which on some sites responsibility for site amenities rested with a succession of different major contractors. On a large project amenities could come under as many as five organisations in succession.

An example of a particularly troubled site

A.167 On one large power station project in a period of four years there were 119 strikes, including sympathy and token strikes. On this particular project the same project group and project management, the same civil engineering consultants and the same main contractors were used as had been used to build a previous similar power station. The only element not repeated was labour. Comparing the two projects at similar stages of completion, on the latter project it took some 15½ months longer to produce the same output.

A.168 Although there was an excessive loss of production time due to strikes, these did not wholly account for the delays. General unrest, which could not be measured, was also a significant factor and had resulted in low productivity and a reluctance on the part of the contractors to build up their labour forces to the required numbers. Despite the fact that contractors had kept the site open for weekend and overtime working the response was very poor.

A.119 Absenteeism and turnover of unskilled labour was abnormally high. It was assessed that the direct loss of work output due to strikes was about 6 per cent but in addition the rate of productivity was only considered to be about 60–70 per cent of what would be expected on a normal site.

A.170 Strikes on this project included the following:

12 recorded strikes on the main foundations contract during the first 18 months.

10 strikes by steelwork erectors on steelwork erection in the main building.

16 strikes on boiler erection to date of report (this phase of the project also included a ban on overtime, a lockout and severe recruitment problems).

Part 2 Statistics of stoppages of work due to industrial disputes

Introduction and summary

A.171 The DEP carried out, in 1965, 1967 and in 1968, three ad hoc surveys of stoppages due to industrial disputes on large industrial construction sites. These surveys fall outside the normal statistics of stoppages prepared by the DEP.

A.172 The surveys cover together the period January 1964 to December 1968. For these 5 years, 718 disputes are recorded on large industrial construction sites, resulting in about 483,652 man days lost. Most of the disputes were unofficial. Two-fifths were about wages. The great majority were on constructional or mechanical engineering work. While we lack a precise measure of days lost per thousand workers, it appears that in this period large industrial construction sites were one of the most strike prone sectors of the economy, exceeded only perhaps by the docks and the motor industry, and the situation has deteriorated even over this short period. It is recognised of course that statistics of stoppages are far from being a comprehensive indicator of the state of industrial relations or of productivity. None the less, it is thought that these figures merit consideration.

Basis and limitations of Tables A.40 and A.41

A.173 The source of the Tables A.40 and A.41 is information provided from regional surveys collated by industrial relations officers (now manpower advisers) of DEP. The first survey covered an 18 month period January 1964 to June 1965, the second survey covered the subsequent 2 year period from July 1965 to June 1967 and the third survey the subsequent 18 months to December 1968.

A.174 It should be noted that no uniform definition of large sites was used in the first two surveys, so that there is no absolute guarantee that all large mechanical sites were covered, although in practice it seems likely that virtually all the more important sites would be covered. Secondly the information required from the regional industrial relations officers was not specified in great detail so that the amount and content of information supplied differed from region to region. Thirdly, although the statistics in this appendix relate

Table A.40 Large construction sites (GB), full summary of all sites 1964–1968

Types of site	Total				Range of contractors			Analysis by cause of stoppage								
	No. of sites	Peak labour force	No. of disputes	No. of days lost	Main	Sub	Site agreement	Bonus	Other wages	Demarcation	Dismissal	Redundancy	Working practices	Site conditions	Sympathy	Others
All Jan. 1964–June 1965	46	63764	169	104616	1–12	1–200+	Yes 11 None 19 NK 16	35	39	10	40	7	12	11	9	6
All July 1965–June 1967	39	49385 NK 2	294	169877	1–40	Nil–100	Yes 10 None 20 NK 9	71	44	16	58	10	25	29	21	20
All July 1967–Dec 1968	46	58171 NK 1	255	209159	1–68	1–70	Yes 18 None 27 NK 1	65	39	8	42	7	10	16	21	47
Total 1964–1968	86	106104	718	483652	1–68	Nil–200+	Yes 29 None 45 NK 12	171	122	34	140	24	47	56	51	73

Note: Total no. of sites, peak labour forces and agreements change because some are covered by all returns. NK=not known

Table A.41 Summary by type of site 1964–68, large construction sites

Types of site	Total				Range of contractors			Stoppages								
	No. of sites	Peak labour force	No. of disputes	No. of days lost	Main	Sub	Site agreement	Bonus	Other wages	Demarcation	Dismissal	Redundancy	Working practices	Site conditions	Sympathy	Others
Power	34	64874	504	316175	1–68	Nil–70	Yes 7 None 24 NK 3	129	86	24	106	16	30	33	37	43
Chemical	15	9619 NK 1	87	72737	1–6	Nil–100	Yes 7 None 6 NK 2	17	12	8	15	1	7	9	7	10 NK 1
Oil	17	22697	88	73998	1–4	1–50	Yes 11 None 4 NK 2	13	18	2	12	5	7	13	3	4 NK 11
Gas	12	5260	33	16254	1–2	Nil–50	Yes 3 None 4 NK 5	9	6	—	7	2	3	1	1	4
Docks	1	150	6	4488	1	NK	Yes 1	3	—	—	—	—	—	—	3	—
Steel works	3	3100	—	—	1–6	Nil–200+	None 3	—	—	—	—	—	—	—	—	—
Water treatment	1	284	—	—	1	—	None 1	—	—	—	—	—	—	—	—	—
Aluminium smelter	2	100 NK 1	—	—	1–3	—	None 2	—	—	—	—	—	—	—	—	—
Aluminium reduction plant	1	20	—	—	2	Few	None 1	—	—	—	—	—	—	—	—	—
All	86	106104	718	483652	1–68	Nil–200+	Yes 29 None 45 NK 12	171	122	34	140	24	47	56	51	73

only to large 'mechanical' sites, the original surveys from which they have been extracted also covered purely building and civil engineering sites, as well as 'mechanical' sites, ie their scope ranged wider than the field covered by the Working Party. The above reservations do not apply to the same extent to the latest survey for which large sites were defined and the information required specified in greater detail.

A.175 A further reservation to be made is that DEP is not informed of all disputes. Moreover DEP's definition of a dispute for statistical purposes excludes stoppages involving fewer than ten workers, and those which last less than one day, except any in which the aggregate number of working days lost exceeds 100. Many minor disputes or occurrences therefore are omitted.

A.176 But the most important reservation of all is that statistics of stoppages are far from being a comprehensive indicator either of industrial relations or of productivity. Productivity may be affected by other forms of industrial action such as restrictions on the flexibility of labour, working to rule, overtime bans, absenteeism, by a general malaise and lack of co-operation between management and workers and by failures in managerial organisation and co-operation.

Main findings

A.177 Over the 5 year period from January 1964 to December 1968 our local records show 718 disputes on all large mechanical construction sites resulting in 483,652 man days lost. The number of stoppages and man days lost seems to have increased over the period.

A.178 The causes of stoppages were as follows:

	%		%
Wages		Working practices	7
Bonus	24	Sympathy	7
Other*	17	Demarcation	5
Dismissal	19	Redundancy	3
Site conditions	8	Other	10

*including disputes over curtailment of overtime.

These figures have to be interpreted with care because causes of disputes may frequently be interrelated (eg disagreements between management and shop stewards over bonuses might lead to dismissals which then caused a strike). These figures make it clear that pay questions, particularly bonuses, account for two-fifths of disputes. Demarcation is evidently not a major cause of disputes but the effect of demarcation restrictions on productivity cannot be judged from these statistics. Though there is some evidence on one or two CEGB sites that demarcation disputes are increasing, this does not seem to be so overall.

A.179 The great majority of stoppages were unofficial.

A.180 What kinds of projects are most strike-prone? In the 5 year period covered by the three surveys, 17 oil refinery sites were known to have had between them 88 disputes involving stoppages; 12 gas plant sites had 33 disputes; 14 chemical plant sites had 87 disputes; 3 steel works had no known disputes; 34 power stations had about 504 disputes. It is not possible to generalise from these figures which conceal wide differences from site to site, except to conclude that power stations appeared to be more susceptible to stoppage than other types of site, particularly over bonuses.

A.181 In order to make satisfactory comparisons between large industrial sites and other sectors of the economy, one really needs an index of days lost per thousand workers. Although DEP maintain such an index for the main industry groups (eg construction) no such index is available for this particular group of large sites which do not constitute a sector for which regular statistics are compiled. A major difficulty in working out such an index for large sites is that we lack figures of the *average* site labour force or the site labour force at any given point in time. In the absence of such statistics the best one can do is to compare days lost with the *peak*, labour force figures which are available; though it should be noted that this is bound greatly to *underestimate* the true level of days lost per thousand workers. Such a comparison shows that in the total period of 5 years covered by the three surveys up to December 1968, 4,554 days were lost per 1,000 workers—6·7 stoppages per 1,000 workers. On an annual basis days lost equalled 911 per 1,000 workers—1·3 stoppages per 1,000 workers. All these sets of figures compare very unfavourably with those for construction generally for the last few years of between 50 and 250 man days lost per 1,000 workers (150 in 1968). Indeed, a large proportion of the stoppages recorded in DEP figures for construction as a whole in fact involve engineering workers on large industrial sites; the Phelps Brown Report commented that in building and civil engineering 'working days lost through disputes tend to be less than in industry generally' (Cmnd. 3714, para 253).

A.182 Even from the very inadequate index of days lost per thousand workers used in the previous paragraph, it is clear that large industrial construction sites are one of the most strike-prone sectors of the economy; exceeded only perhaps by port and inland water transport and motor vehicle manufacture.

Appendix 4 Comparison of agreements operating on large industrial construction sites

The Agreements outlined in this appendix were correct at 1 December, 1969, but it should be borne in mind that they are subject to periodic revision.

The wording of the Agreements has been substantially altered in the interests of brevity; in cases of doubt the original Agreements should be consulted.

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
1 Holidays						
(a) *Annual holiday* (i) Duration	2 weeks, four days	as in col 1	3 weeks = 15 days	2 standard working weeks	as in col 1	as in col 1
(ii) period	—	—	10 days between 1 June and 31 October 5 days at Christmas (England and Wales) 5 days at New Year (Scotland) No carrying forward to next holiday period	1 June to 31 May (cannot be carried forward to next holiday period)	Staggered by mutual agreement	1 May to 31 October by mutual agreement
(iii) Amount credited for each full week's work performed	3/49 agreed rate plus 1/3, or 3/49 of rate at present used for calculating holiday credits whichever is greater	as in col 1	Improvers, fitters and 2 grades of fitters/welders: 2s 8d per week Mates and assistants 20s 4d per week (Further increases from 1 June 1970 and 31 May 1971)	Technician: 20s per week Approved electrician: 17s per week Electrician: 16s per week Trainee electrician or labourer: 12s per week	1/25 of rate under Outside Steelwork Erection Agreement plus 1/3 If less than 40 hours worked appropriate proportion of full week's allowance; in case of sick leave appropriate credit up to 12 weeks in any one year	as in col 1
(b) *Customary holidays* (i) Number of days	six	as in col 1	1969: 4 1970: 5 1971: 6	as in col 1	ten	as in col 5
(ii) Designated days	*England, Wales and Northern Ireland* Christmas Day or day following if on Sunday Good Friday or Easter Monday depending on local custom *Scotland* New Year's Day or day following if on Sunday Other days depending on	as in col 1	*England and Wales* 1969: Good Friday Easter Monday Whit Monday Spring Bank Holiday Late Summer Bank Holiday 1970: As above plus 1 day to be New Year's Day at employer's discretion	Good Friday Easter Monday Spring Bank Holiday Late Summer Christmas Day Boxing Day Subject to agreed substitution	Christmas Day Boxing Day Good Friday Easter Monday Bank Monday in lieu of Whit August Bank Holiday Holiday plus four days subject to annual and mutual agreement	New Year's Day: (allowing for Sundays) and two working days following one day Spring, two days Autumn: plus four days by mutual agreement

	local custom in engineering industry		1971: As 1970 plus 1 day *Scotland* 1969: 2 days Spring 1 day Autumn 1 day Christmas 1970: 3 days Spring 1 day Autumn 1 day Christmas 1971: 3 days Spring 1 day Autumn 1 day Christmas 1 other day			
(iii) Payment	—	—	Normal daily rates	as in col 3	—	—
(iv) Payment for work done on holidays	*England, Wales and Northern Ireland* Christmas Day and Good Friday: (subject to Sundays and local custom) double time *Scotland* New Year's Day (subject to Sundays) and one other day depending on local custom: double time Other days: time and a half	as in col 1 except Northern Ireland	Minimum of two hours at appropriate rate *England and Wales* Christmas Day double time *Scotland* first three working days of the year, Spring Holiday and Friday before Autumn Holiday (1 day) double time Other days: first eight hours time and a half thereafter double time Also for each day worked a day's holiday with basic pay at mutually agreed date	*Day workers* *Christmas Day* double time and a day's holiday paid at basic time rate for normal working day *Other days* time and a half plus day off in lieu as above, or (at discretion of employer) 2½ times basic pay and no day in lieu *Night shift workers* when entitled day shift basic day's pay. Hours worked (midnight to midnight) Christmas Day double night shift rate of time and a third without night in lieu. All other paid holidays time and a half on night rate of time and a third without night in lieu Overtime on paid holiday time and a half on time and a third except Christmas Day at double time and a third	Six statutory days double time for all hours worked, plus day off in lieu with pay Extra four days: normal time rates and day off in lieu	Two statutory days (depending on local custom) double time plus day off in lieu Four statutory days: time and a half plus day in lieu Extra four days: normal time rates and day off in lieu

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
Holidays(cont'd) (v) Conditions	—	—	Normal days work on the working days preceding and following the holiday unless employer satisfied absence beyond operatives control	(i) Full time is worked on working day preceding holiday (ii) Report at normal time and work full time on working day after holiday (except in case of permission or annual paid holiday)	as in col 4	as in col 4
2 Special allowance for conditions						
(a) *Height money* (i) height	50 feet or more from basement floor level upon open structures or from nearest filled in floor level in case of (i) adjacent or above opening (ii) when handling materials over parapet	50 feet or more on any type of structure	Work in swings or cradles, 2d per hour for time actually worked Work on ladders, 2d per hour for time actually worked at 20 ft + 2d per hour for each 10 ft		30 feet or more, unless protective rails or walls	as in col 5
(ii) scale of allowance	*feet* *per hour* 50–75 2d 75–100 4d 100–150 6d 150–200 1s 0d an additional 6d for each additional 50 feet	as in col 1			*feet* *per hour* 30–75 2d 75–100 4d 100–150 6d 150–200 1s 0d 200–250 1s 6d an addition of 6d for each additional 50 feet	*feet* *per hour* 30–60 2d 60–90 4d 90–120 6d 120–150 8d an addition of 2d for each additional 30 feet
(b) *Abnormal conditions*	(i) contact with flue deposits: 3d per hour additional; when corrosive: 6d per hour (ii) Other, including excessive dirt, heat or fumes: maximum addition 3d per hour (iii) Muddy conditions: rubber boots and 1d per hour addition	(i) excessive dirt: maximum additional 3d per hour. Also heat fumes: similar additions, maximum of both not to exceed 6d per hour *South Wales* to meet special circumstances maximum of 6d per hour	Dirty work or work under abnormal conditions equally onerous: 3s 6d per day or part of day	(i) Collieries: underground at time and a quarter; shaft at double time (ii) accumulators (not erecting other than portable sealed batteries): 2s 6d per day (any hours)	(i) Confined space: 2d per hour (ii) Columns and vessels, with internal fittings *feet* *per hour* 8+ 3d 8–5 4d 5–3 6d 3– 1s 0d (iii) stacks and pipes	as in col 5 (ii)

		(ii) noxious or dangerous fumes or acids: special allowance by agreement (iii) as in col 1 (iii)		Apart from above and payment of responsibility money to Approved Electricians, no deviation from JIB graded wage rate except by authority of JIB	*feet* *s* *d* 5–3 6 3– 1 0 (iv) Obnoxious fumes 3d per hour; with gas masks; 1s per hour (v) excessive heat: 3d per hour (vi) asbestos or glass wool air-borne residue: asbestos lagging: 2d per hour glass wool 4d per hour (vii) cradles or floats 1d per hour (viii) Boatswain chairs: 2d per hour (ix) welding stainless steel: 6d per hour (x) non-smoking: 4½d per hour (except in meal and tea breaks)	(x) non-smoking when required no payment
3 Merit responsibility payments	—	—	at employer's discretion for mobility, loyalty, long service, etc and for special skill over and above that detailed in definition of operative's grade. Chargehands receive extra remuneration (amount unspecified)	—	—	1s 3d per hour to chargehands enhanced where overtime is worked

Proficiency payments are too numerous and detailed and would have to be the subject of a separate study

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
4 Meals and tea breaks (a) *Normal lunch*	Work during meal break paid at overtime rates if no equivalent period is allowed	as in col 1	1 hour; except when impossible for normal working day then reduced to not less than ½ hour	1 break not more than 1 hour except on Saturday; also as in col 1	Mid-day break of ¾ hour without pay. Also as in col 1	As in col 1, but may be reduced to 30 mins. Also as in col 1 and equivalent unpaid interval granted
(b) *Tea break*	—	—	Morning and afternoon duration minimum possible and drunk on site; no loss of pay	Time permitted not to be exceeded	10 minutes in morning with pay	As in col 5 taken in work area
(c) *Overtime breaks*	—	—	¼ hour with pay at overtime rate for each 2 hours work in excess of normal: Saturday, Sunday, holiday (normal shall be 8 hours): this to replace tea breaks	—	10 minutes paid up to 2 hours overtime; 30 minutes paid from 2 to 4 hours overtime: Saturday and Sunday in excess of 8 hours	10 minutes unpaid at normal finishing time when overtime more than 2 hours
5 Welfare facilities on site	—	—	Responsibilities under Construction Regulations	As in col 3	(i) drying rooms (ii) first aid post (iii) canteen to provide hot mid-day meals at reasonable charges (iv) reasonable facilities for meals during overtime	—
6 Termination of employment *After 2 years in accordance with statutory requirements* (a) *Period of notice by either party* (*in case of misconduct*)	Continuous employment for not less than 4 pay weeks: equivalent to non-overtime weekly	As in col 1	(a) Contract from hour to hour (b) period of continuous employment of less than	During first 26 weeks 'Continuous employment' 1 hours notice or 1 hours pay	(a) Less than 4 weeks 2 hours to expire at end of normal day; (b) more than 4 weeks	4 weeks service and over 40 hours to terminate on Friday (applies in cases of unsatisfactory

	hours in operation		13 weeks: (i) first 5 days by not less than 2 hours expiring at end of normal day (ii) after first 5 days: one day expiring normal finishing time on Friday (iii) 13 weeks or more but less than 2 years on any day by one weeks notice		service 40 hours	work or bad time keeping)
(b) *Misconduct*	—	—	Summarily discharged	Instant dismissal	As in col 3	As in col 3. Also in case of smoking in specified places
7 Overtime (a) *Intention to reduce*	—	—	Programme for reducing overtime; second and third wage rate increases dependent on success of this programme	Deprecated by both parties and to be avoided as far as possible. Systematic overtime in particular to be avoided. NFEA give immediate consideration to any representations by ETU	Only when necessary to maintain planned schedules	as in col 5
(b) *Limits*	—	—	see (i) above	not more than 30 hours in any 4 weeks except in case of breakdowns, emergency repairs and replacements, and completion of work against contract dates	—	—
(c) *Conditions*	a full day worked first, except (i) time lost through certified sickness (ii) laying off because work all previous night (iii) absence with leave or enforced idleness	as in col 1	as in col 1	as in col 1	as in col 1	as in col 1
(d) *Payment* (i) Monday to Friday first two hours	time and one third	as in col 1	time and a quarter	as in col 1	time and a half until midnight, thereafter double time	time and a half until midnight, thereafter double time

7 Overtime (cont'd)	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
(ii) Saturday	time and a half	as in col 1, but add 'by dayshift'	first five hours time and a half thereafter double time	first 2 hours time and a third, thereafter time and a half	up to 4pm time and a half, thereafter double time	as in col 5
next two hours	time and a half	as in col 1	as in col 1	as in col 1	as in col 1	as in col 1
next two hours	time and a half	as in col 1	double time	time and two-thirds		
thereafter	time and a half	as in col 1	double time	double time		
(iii) Sunday	double time	as in col 1	as in col 1	as in col 1		
(iv) if sent home between midnight and 2am	time and a half for hours worked and basic rate for remainder up to 6am	as in col 1		time and a half until 6am (if over 2 miles and no transport or accommodation, if under 2 miles 1 hour walking time at ordinary rates)	after midnight double time for hours worked, thereafter basic rates until starting time	double time for hours worked, thereafter basic rate
(v) if sent home after 2am	time and a half for hours worked since midnight; time and a half for hours up to 6am	as in col 1	—	—	—	double time for hours worked, thereafter time and a half
(vi) Holidays: England and Wales Christmas	—	—	double time	double time and day off in lieu at basic rate	as in col 4	—
Others	—	—	normal hours at time and half, thereafter double	time and half and day off in lieu at basic rate: or 2½ times basic rate	as above	—
Holidays: Scotland	—	—	double time	local substitution of recognised holidays	—	site closed
(e) *Calculation*	on day rates	as in col 1	—	on inclusion wage rate	day to day basis, as in col 1	as in col 1
8 Hours of work *Working week*	40 hours worked on 5 days (Monday to Friday)	as in col 1	as in col 1 unless otherwise agreed by employer and operative	40 hours per week worked over 5 or 5½ days at sole discretion of employer. If 5 days—between 7.30am and 6.30pm. If 5½ days—between 7.30am and 6pm. Not more than 4 hours to terminate not later than 1pm on Saturday. Working days and hours declared by employer on each contract	as in col 1 Starting and finishing times mutually determined at site level subject to job requirements and transport facilities	as in col 1

Guaranteed week	if continuously employed by employer for 4 weeks assured of earnings equivalent to consolidated time rate for 40 hours	as in col 1	if continuously employed by employer for 2 weeks assured of equivalent of inclusive hourly normal time earnings for 40 hours	—	guaranteed minimum weekly pay of 40 hours at basic hourly rate	if continuously employed by employer for four weeks, guaranteed minimum weekly pay of 40 hours at basic hourly rate
Conditions to apply (i) availability	available for work on usual occupation or reasonable alternative	as in col 1	as in col 1	—	as in col 1	as in col 1
(ii) redundancy and holidays	where approved short time is an alternative to redundancy, or in case of recognised holiday, period of guarantee reduced proportionately	as in col 1	in case of holidays reduction of 8 hours for each day of holiday	—	as in col 6	in case of holiday reduced proportionately
(iii) disputes	suspended in the event of a dispute	as in col 1	as in col 1 but in case of a dispute by operatives working under other agreements alternative work or return to shop	—	failures, apart from (a) (ii) above to present himself for work for any other cause shall entail loss of guaranteed minimum payment for hours lost	as in col 1
(iv) overtime	premium payments for overtime ignored	as in col 1	—	—	Straight time for overtime not worked on Saturday and Sunday	overtime worked on weekdays, Sundays and holidays ignored when computing assured earnings
(v) duration	—	—	—	—	—	—
9 Protective clothing	—	—	—	provided free of charge where there is a satisfactory obligation; rubber boots, waterproofs, industrial gloves provided where necessary, loss is responsibility of operative	safety helmets provided and compulsory on site; oilskins, leggings and rubber boots provided; special consideration in individual cases; all to remain property of contractors	safety helmets provided and compulsory on site; non-wearing may lead to dismissal; as in col 5

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
10 Tools	—	—	(a) operative to provide rule and spirit level (b) other tools provided by employer (c) operative to take reasonable care	(a) kit of tools as set out to be in possession of electricians, electrical fitters and adult assistants (b) employers not responsible for loss or damage (c) employers advised to insure against loss or theft (d) lock up to be provided where possible	—	—
11 Shiftwork						
(a) *Nightshift* (i) Definition	(a) Work throughout night for not less than 3 continuous nights	(a) as in col 1	Work throughout at least 5 consecutive nights (if less than 5 nights, but not working during day at overtime rates)	(a) as in col 1	(a) Work throughout night for not less than 5 nights	(a) as in col 1
	(b) full week consists of 40 hours on 5 nights with 1 or 2 meal breaks as arranged	(b) as in col 1		(b) as in col 1	(b) as in col 1 (Monday to Friday)	(b) as in col 1
	(c) time lost through certified sick leave, laying off because of work during previous day, absence with leave or enforced absence not taken into account					
(ii) Payment	(a) Time and one third	(a) as in col 1	(a) Time and quarter	(a) as in col 1	(a) as in col 1	(a) as in col 1
	(b) After full night time and half	(b) as in col 1	(b) Overtime as for normal overtime on basic night shift rate	(b) After full night at time and two thirds	(b) as in col 4	(b) as in col 4
	(c) Between midnight Saturday and midnight Sunday—double time	(c) as in col 1		(c) as in col 1 Other work on Saturday and Monday at time and two thirds	(c) Between 4pm Saturday and Sunday midnight at double time	(c) as in col 5
	(d) Calculations on dayshift rates	(d) as in col 1	(d) as in col 1	(d) as in col 1		

(b) *Double dayshift and/or shift system* (i) Definition	5 shifts of 7½ hours Monday to Friday ie 37½ working hours; half hour for meals	as in col 1	2 or 3 shifts of 8 hours	—	By mutual agreement	—
(ii) Recommended division	1st shift: 6am–2pm 2nd shift: 2pm–10pm 3rd shift: 10pm–6am	as in col 1	Arrangements to be made to change shifts worked by each operative	—	As above	—
(iii) Payment	Normal week of 37½ hours at 44 hours of consolidated time rate for 1st and 2nd shifts, and 48 hours for third shift. In case of man continuing in place of worker in succeeding shift, former shall be paid for extra hours at his shift rate or succeeding rate, whichever is higher	as in col 1 except 'consolidated'	Time and a third in case of six day shift; time and half in case of seven day shift Overtime and night shift rates compounded in these rates	—	By mutual agreement	—
	If for any other reason work beyond normal hours, overtime rates based on consolidated time rate	as in col 1 except 'consolidated'				
	Overtime on Saturdays at time and half, and on Sundays at double until midnight	as in col 1				
12 Trade union facilities (a) *Stewards*	appointment determined by union to represent members of only his own federated employers: his name to be officially given to employer by union; shall be afforded time to deal with questions raised by agreement with management, but otherwise to conform to normal working conditions	—	number on any site agreed by employer and local union but not to exceed 1 for each 20 operatives; in case of 1 steward on site a deputy may be elected to act in absence of steward; must be craftsman of 21 years and continuously employed by employer for at least 12 months; election on site during working hours at time determined by employer, all operatives attending to receive ¼ hour basic for time at election; office to be held for 12 months, and can be re-elected; reasonable facilities given for him to carry out his duties	—	represent only those members employed by his contractor, and confined to his employer's area; reasonable opportunities allowed to full time officials	represent only those members employed by his contractors; name to be given in writing to employer; obtain permission before leaving place of work on union business; otherwise to conform to normal conditions

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
12 Trade union facilities (cont'd) (b) *Meetings*	—	—	(a) prior notice to employer and local union official, latter to know subject matter (b) not to be held in working hours without prior agreement with employer (c) unpaid unless held at request of employer	(b) as in col 3	(b) as in col 3	meetings of stewards allowed during last hour on Fridays; pay at basic rate; not general meetings on site
13 Disputes procedures	(a) Conference on site or where mutually agreed by local officials of employers' federation and union without delay (b) then conference between federation and executive of union (c) no stoppage of work until agreed procedures carried through	(a) local official of federation of area and official of union within 7 working days (b) then next monthly meeting of statutory conference, held on second Tuesday of each month, particulars to be supplied at least 10 days before (c) as in col 1 (c)	(a) referred to local union official (b) if relating solely to interpretations of national agreement then referred to Joint Conciliation Committee (c) otherwise local conferences within 7 workings days then national conference within 14 working days of local conference (d) pending a decision at local conference, national conference or Joint Conciliation Committee level, no stoppage, work to continue under current conditions except when chief officials	(a) referred to NJIC (b) local dispute not settled within 48 hours referred to Joint Industrial Council to meet within 3 working days of application for meeting (c) as in col 1 (c)	(a) referred to site agent (b) referred to site conference within 7 days (c) failing settlement if affecting more than one contractor referred to local conference off-site (d) then referred to general secretaries of signatory unions	(a) referred to site industrial relations officer (b) then full time local official and meeting within 7 days (c) then central conference off-site within 7 days of union local officials and employers' representatives signatory to agreement (d) then conferences of union national officials and employers' representatives

			of association and union agree this may prejudice an early settlement			
14 Demarcation	—	—	prevention of demarcation problems arising part of new three year agreement	—	no stoppage; discussion with stewards, where one craft is doing work to continue pending decision by full time officials; where more than one craft doing work balanced gang to continue until decision by full time officials; officials to meet within 7 days, union official not involved to be chairman; then referred to executive of unions involved for urgent decision	unions signatory to the agreement have the right to submit and employers to accept for employment any member with the necessary skills regardless of past practices or demarcation agreements; further, when suitable labour is not available, employers may recruit members of National Union of Structural Workers, Coppersmiths, Heating and Domestic Engineers Trade Union, although this Union is not signatory to the agreement; again interchangeability between crafts may be permitted in order to maintain production in the event of an unbalanced labour force occasioned by abnormal job conditions. Demarcations are prescribed for certain specified forms of working
15 Incentive schemes	when negotiating incentive schemes or lieu bonuses unwise to refer to earnings levels of time and half, double time, etc. Some increases implicit in wage structure	as in col 1	national agreement silent but some incentive schemes are operated. Association undertaken to commission management consultants to undertake survey on possibility of laying down principles of guidance for introduction of incentive schemes by firms	not permitted	bonus scheme in operation with common norms (specified)	incentive bonus schemes precluded by nature of work: wage rates and conditions of employment established by productivity bargaining

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
16 Wages rates						
(a) *Craftsmen per hour*	at 20.1.69 eg erectors, riggers, etc 8s 9¼d	at 20.1.69 as in col 1	at 24.2.69 eg fitters London 9s 2½d Other 9s 1½d	at 2.9.68 eg electricians London 9s 5d Mersey 9s Other 9s	at 20.5.69 skilled craftsmen 11s (includes boot money, mud and dirty conditions)	at 1.7.69 skilled craftsmen 11s 6d (includes all condition payments except height money and confined space)
(b) *Labourers per hour*	at 20.1.69 7s 2d	at 20.1.69 as in col 1	at 24.2.69 Mate: London 7s 7d Other 7s 6d	at 2.9.68 London 7s 6½d Mersey 7s 2½d Other 7s 2½d	at 20.5.69 8s 3d	at 1.7.69 7s 10d
17 Daily and periodic travelling and lodging allowances						
(a) *Grade of operative eligible*	craftsman and labourer	as in col 1	fitter/welder (gas/arc) fitter/welder (gas or arc) fitter improver assistant mate junior mate	skilled operative (technician, approved electrician and electrician) labourer apprentice	workpeople employed by the contractors and their subcontractors excluding those engaged on building or civil engineering works, tankage construction and thermal insulation installations, ie all construction and associated commissioning work which is obviously of a mechanical nature	all hourly paid chargehands and skilled craftsmen engaged on mechanical construction. It excludes all building and civil engineering operatives covered by the Working Rule Agreements of the NJC for the Building Industry and the Civil Engineering Construction Board and the catering staff of canteens
(b) *Travelling—daily* (i) Definition of centre for purposes of measuring distances	man's home	as in col 1	(a) job, if engaged on understanding that job will be centre (b) within two miles of operative's centre, employment exchange if possible	(a) shop recruited: shop (b) site recruited: council centre (for man's home in rural areas)	post office nearest to man's home	as in col 5
(ii) Measurement of distance in miles	straight line from man's home to site: exceptional cases may be raised with employer in accordance with agreed procedure	straight line from centre to site: otherwise as in col 1	straight line	straight line from centre, home or shop to site	straight line: special consideration may be given if shortest available road route to site is one-third larger than distance as measured in a straight line	straight lines: in case of natural obstacles circuitous route may be used

(iii) Payment of fares to pick-up points or from 'shop' to job	by arrangement with employer if distance over 2 miles each way an extra 1s 6d per day, if this plus normal radius allowance does not exceed 21s 6d per day	as in col 1	return daily travelling fares from centre to job	up to and including 15 miles from shop to job and job to shop: time ordinary rates and actual fares over 15 miles can elect to lodge; if elect to travel, 18s daily in lieu of travelling time (except in lieu payment in London and Mersey) and all fares	—	actual bus fares where pick-up point exceeds 1½ miles on production of bus ticket
(c) *Daily travelling allowance* (i) When free transport is provided	*Miles each way* *Over* / *not exceeding* / *allowance s d* 2 / 5 / 3 4 5 / 8 / 4 8 8 / 11 / 6 8 11 / 14 / 8 4 14 / 17 / 10 8 17 / 20 / 12 4 20 / — / 14 4	as in col 1		No reduction in travelling allowances except in case of site recruited operatives when only 50% of radius payment under b(iii) below is payable	as in col 1	*Distance one way* *Miles* *Over* / *not exceeding* / *allowance s d* 1½ / 5 / 3 4 5 / 8 / 4 8 8 / 11 / 6 8 11 / 14 / 8 4 14 / 17 / 10 8 17 / 20 / 12 4 20 / — / 14 4
(ii) When employee makes his own arrangement	*Distance each way* *Miles* *Over* / *not exceeding* / *allowance s d* 2 / 5 / 5 0 5 / 8 / 7 0 8 / 11 / 10 0 11 / 14 / 12 6 14 / 17 / 16 0 17 / 20 / 18 6 20 / — / 21 6	as in col 1	*Centre to job* *Miles* *Over* / *not exceeding* / *allowance* C* *s d* / M & A† *s d* 0 / 2 / 2 5 / 2 1 2 / 5 / 4 10 / 4 2 5 / 10 / 6 5 / 5 6 10 / 15 / 8 10 / 7 7 15 / 20 / 12 1 / 10 5 20 / 25 / 15 4 / 13 2 25 / 30 / 18 6 / 15 11 30 / — / 36 6 / 36 6	(a) *London (Grade 'A') and Mersey* *All shop and site recruited operatives engaged in London and Mersey districts* paid hourly wage rate which includes an element of 9d per hour for travelling time (proportionately less for apprentices and 7d per hour for labourers) up to 15 miles from the shop (b) *Rest of country (Grade 'B')* (i) *Shop recruited operatives engaged at employer's shop in rest of country* *Shop to job Daily travelling time payment at ordinary rates in addition to fares*	as in col 1	*Distance one way* *Miles* *Over* / *not exceeding* / *allowance s d* 1½ / 5 / 5 0 5 / 8 / 7 0 8 / 11 / 10 0 11 / 14 / 12 6 14 / 17 / 16 0 17 / 20 / 18 6 20 / — / 21 6

*Fitter/welder (both grades) fitter and improver
†Assistant, mate, junior mate

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
17 Daily and periodic travelling and lodging allowances (cont'd)			The daily travelling allowance is a payment for travelling time only and actual fares are payable in addition. The radius allowance payable beyond 30 miles is a payment for travelling time *and* fares	Distance each way (miles) up to 1 nil up to 2 20 mins/day up to 3 30 mins/day up to 4 40 mins/day up to 5 50 mins/day 6 to 10 75 mins/day 11 to 15 100 mins/day (ii) *Site recruited operatives engaged on sites outside rural areas* As above but distance taken from Council centre to site (iii) *Site recruited operatives engaged on sites in rural areas* *Distance each way* — *allowance* *s d* up to 10 miles 6 0 10 to 15 miles 9 0 Distances beyond 15 miles 12 0 (Also paid where transport optionally available at no cost to operative or employer) (c) *Distance over 15 miles from shop—all areas—shop recruited men only* For distances, from shop, over 15 miles: (a) Country allowance of 18s when electing to travel, or (b) Lodging allowance of £1 when actually lodging		

(d) *Lodging allowances* (i) Proof of necessity for Inland Revenue	agreement or arrangement with employer	as in col 1	signed statement by operative, preferably on suggested pro-forma	operative to provide proof	operative must complete an 'Application for Lodging Allowance' form	as in col 5
(ii) Amount of allowance	21s 6d per day or £7 10s 6d per week on basis of 7 day week	as in col 1	30s per night	20s per night	21s 6d per day or £7 10s 6d per week	as in col 5
(iii) Cases in which payment is not made	in cases of broken week at beginning and end of contract	as in col 1	(a) if operative is engaged at job or if centre is job (b) if operative not in lodgings (c) if operative absent without permission (d) when lodgings arranged by employer	(a) if engaged on site (b) if arranged at no cost to operative	unauthorised absence	during absence except authorised leave
(iv) Sickness or accident necessitating man remaining in lodging	dealt with sympathetically on merits	as in col 1	—	operative must produce a medical certificate	—	Sympathetic consideration on receipt of medical certificate, up to 14 days absence
(v) Holidays other than annual	retainer of 10s per day	as in col 1	nightly lodging allowance	—	as in col 1	allowance continues during authorised absence
(vi) Annual holiday	retainer of actual amount up to 40s per week upon proof of payment	as in col 1	no allowance	retention fee of actual amount up to 20s per week on proof of payment	as in col 1	retainer of 10s per day
(e) *Periodic leave for men in lodgings* (i) Frequency	six during year: (a) between Christmas and Easter (b) between August and Christmas (c) at four recognised holiday periods	four recognised holiday periods and once between August and Christmas	every two weeks	every six weeks	every six weeks advanced or retarded not more than two weeks to meet exigencies and holidays	every six weeks; variations to meet exigencies and public and annual holidays
(ii) Fare	second class return	return fare	return fare	return fares from job to shop	second class fares	free warrant for return second class fare up to eight per year
(iii) Time	return journey back to site at single time rate	as in col 1	normal time rate from centre to job	none	time rate on return journey except over 100 miles when one hour at time rate for each 25 miles of return journey	as in col 5

	(1) Steam generating plant erection agreement	(2) Outside steel erection	(3) Heating, ventilating, air-conditioning, piping and domestic engineering	(4) Electrical contracting	(5) Site agreement at Coryton	(6) Site agreement at Grangemouth
17 Daily and periodic travelling and lodging allowance (cont'd) (f) *Travel on commencement and termination of employment* (i) Distance	agreed personal base and site	place of engagement and site	exceeding 30 miles from centre	employer's shop to job if over 15 miles	home or place of engagement and site	straight line: man's home or place of embarkation in UK and site
(ii) Fare at commencement	railway, bus or steamer fares or vouchers for second class travel	as in col 1	fare from centre to job	actual fare	second class fare from home or place of engagement	free travel warrant or 2nd class fare
(iii) Travel time at commencement	single time rate	as in col 1	normal time rate	ordinary rates	time rates	basic hourly rate on actual time, except where over 100 miles, when 1 hour at basic rate for each 25 miles
(iv) Fare at termination	as for commencement, except where man can be reasonably transferred to another site	as in col 1	fare	actual fare	second class fare	(by implication as for commencement)
(v) Travel time at termination	as for commencement, except where man can be reasonably transferred to another site	as in col 1	normal time rate	ordinary rates	time rates (except in case of voluntary discharge. On compassionate reasons acceptable to employer, fare and time paid)	(by implication as for commencement)
(g) *Travel between lodgings and site*	(proof of satisfaction to employer) special consideration if lodging not close to site	as in col 1	daily return fares if lodging is not available within two miles from job	in excess of 2s per day in excess of ½ hour each way	not paid to men in receipt of lodging allowance unless unable to obtain lodgings near site: shall not exceed scales in (c) (i) and (ii) up to maximum of 14 miles	not paid to men in receipt of lodging allowance but special consideration if unable to obtain lodgings near site: not to exceed scale 5 miles to 8 miles

Appendix 5 Large industrial projects - construction plans and achievements

A.183 This appendix compares the plans for the construction of some large oil, chemical and power projects in recent years, against what was actually achieved, in terms of time taken and costs. The tables are based on information submitted by most of the major clients in the industry.

A.184 The gravity of the problems facing the industry can be seen by the fact that in each sector concerned with the construction of large industrial projects, there have been lengthy commissioning delays and excess costs. Doubtless the causes—such as late design changes, procurement delays, industrial strife—are common to all sectors, but it should also be borne in mind that sanction for a large project is often granted on a preliminary estimate prepared before the project has been closely defined and costed, and the actual cost will almost inevitably differ. The same applies to the time scale allowed for building.

Power stations

A.185 Details of excess costs and building programme delays at a selection of power stations recently completed in GB or still under construction, are given in Table A.42.

Table A.42 GB power station projects: excess costs and programme delays

Power station	Capital costs (estimates)			Delays in completion (months)					Original construction period (months)†
	Original* £m	Current £m	Increase %	1st set	2nd set	3rd set	4th set	5th set	
1	50·96	57·60	13	25	17	9	8**	9	88
2	23·28	18·17	—	3	6	6			60
3	49·64	67·70	36	24	24	29	35		69
4	44·00	65·83	50	24	24				60
5	65·82	79·81‡	21	5	14	3	—		72
6	20·86	18·15	—	—	—	—	5	4	35
7	70·78	84·44	19	14	17	8	8		79
8	75·80	100·80	33	29	27	26	27		77
9	52·45	55·56	6	18	6	5	6		78
10	71·60	84·91	19	6	6	3	15		67
11	79·45	93·30	17	7	7	4	3		67
12	78·50	96·50	23	7	3	2	2		83
13	93·65	105·37	13	16					86

*Does not include any contingency sum or provision for inflation during progress of work.
†From site starting date to original programmed completion date, ie synchronising of last unit.
**Based on first synchronising date: resynchronised 2 years later following accident.
‡Includes £3·5m for cooling towers reconstruction.

Oil, chemical and gas plant A.186 Similar data for these projects are given in Tables A.43 and A.44.

Table A.43 Some major oil and chemical plant projects constructed in recent years

Type of project	Capital appropriated, £m		Excess cost, %	Duration of construction (months)		
	Adopted	Actual		Planned	Actual	Delay
Refinery expansion	2·80	3·45	23	18	24	6
Refinery expansion	2·28	2·20	—	18	19	1
Refinery expansion	8·20	7·15	—	20	25	5
New refinery	19·30	25·68	33	25	34	9
New refinery	10·50	11·30	8	21	21½	½
New refinery	18·45	18·60	8	24½	24½	—
Oil and chemical plant	3·10	3·50	13	21	29	8
Oil and chemical plant	6·40	8·10	27	12	19	7
Oil and chemical plant	6·46	7·66	19	23	23	—
Oil and chemical plant	4·32	4·20	—	24	23	—
Oil and chemical plant	7·11	7·32	3	18	19¾	1¾
Oil and chemical plant	10·55	9·70	—	27	27	—
Oil and chemical plant	8·20	7·15	—	20	25	5
Electricity generating plant	1·78	1·80	1	16	23	7
Electricity generating plant	6·89	7·10	3	28–30	30–31	2–1
Electricity generating plant	2·00	2·20	10	20	28	8

Table A.44 Some major oil gasification plants constructed since 1961

Plant	Capital appropriated, £m		Excess cost, %	Delay in commissioning (months)
	Adopted	Actual		
1	6·70	7·80	16	14
2	10·80	11·57	7	2
3	5·94	5·91	—	—
4	5·41	6·00	11	13
5	3·85	3·95	3	½
6	7·60	8·86	17	8
7	7·52	9·26	23	23

Note
The construction period for these plants usually covered a period of two to three years. The commissioning delays specified only cover the last unit of the plant. There were often corresponding delays in commissioning the other units of the plant.

Appendix 6 Shiftworking: the feasibility and economics of multiple shifts on mechanical work at large construction sites

A.187 Mr F Fishwick and Mr C J Harling of the Cranfield School of Management studied the scope for shiftworking, and their report is summarised below.

Introduction

A.188 Much of the information on which the report is based relates to two projects: the new power station at Longannet, Fifeshire and the major extensions to the oil and petrochemical complex at Grangemouth, Sterlingshire. Contractors undertaking mechanical work at other sites were also consulted and some further information was obtained by correspondence with continental companies.

A.189 The writers recognise that the general application of shiftwork on sites where delays exist because of labour disputes, late deliveries or design changes might increase on-site costs without any appreciable advancement of completion. However, in order to identify the economics of shiftwork to be considered in future planning, they have assumed that all these sources of delay could be eliminated.

The potential benefits of shiftwork

A.190 A distinction is made between projects already under construction and future projects.

Projects under construction

A.191 The advantages to the client of earlier completion will often depend on the size and nature of the market for the final product. The report stresses that the cost of delay must be regarded as an opportunity cost and measured in terms of lost revenue, not in terms of the cost of capital already expended on the project.

A.192 Accelerated construction of current projects would benefit those contractors who receive progress payments at various stages of an agreed construction programme, a system used in most power station projects. Where contractors are reimbursed at regular intervals this advantage does not occur. The report expresses some doubt about the argument that shiftwork offers contractors better utilisation of plant and equipment. At times of slack demand, this argument may apply only to hired items.

Future projects

A.193 The major advantages of a shorter construction period (and longer planning and design period) would be as follows:

(a) Because the 'Forecasting Period' is reduced investment could be more accurately related to demand requirements.

(b) Reduction in the number of design changes during construction.

(c) Better utilisation of contractors' fixed assets: with present construction methods a given volume of construction over the country as a whole might require a smaller total inventory of plant and equipment. The possibility that more capital-intensive methods might become economical is also suggested.

(d) Capital need be tied up for shorter periods. While the use of shiftwork may increase total expenditure on a project, this increase is likely to be more than offset by capital savings which result from incurring that expenditure over a shorter period. A method of calculating these savings is given in the report.

Practical considerations

A.194 The writers encountered very few instances where shiftwork had been planned from the outset of a project and incorporated in construction schedules. Many contractors have used it on a contingency basis, as a means of regaining lost time.

A.195 Lighting requirements usually determine the facility with which a particular task may be carried out at night, though low temperatures and fog affect outdoor work in winter. Within the partly completed, well lit generating building of a power station there are generally fewer problems in nightwork than on open air sites. On these, nightwork can most easily be applied to activities requiring only local lighting and minimal movement of men or materials around the site. Welding normally satisfies these criteria; other activities on oil and petrochemical sites which can be undertaken at night include the traying of columns, radiographic and ultrasonic testing and, possibly, on-site prefabrication.

A.196 *Productivity* at night varies according to the nature of the work, the physical environment and supervision. The possible existence of accepted norms at various sites complicates analysis. Estimates of productivity at night in welding made by engineers with experience of such nightwork at oil and petrochemical sites varied from 40 to 75 per cent of that achieved during the day. Most of those interviewed considered that in the planning of future projects this ratio could most reasonably be assumed to be two-thirds. At the power station site, productivity in certain activities had been higher at night than by day. This results partly from the small size of the night shift, which permits greater flexibility and reduces congestion. In addition, the night shift was allocated comparatively straightforward, continuous work. Finally, compared with the open site, there is much less difference between day and night working conditions.

A.197 *Supervision and organisation:* at both sites, shiftwork had posed few supervisory problems. With small night shifts, usually engaged on straightforward work, few formal meetings between senior staff and night supervisors or between day and night foremen were required. Apart from informal visits at night by senior engineers, the principal means of communication were written documents or the telephone. While larger night shifts would require more formal supervision, the scope for large scale nightwork may, in many projects be limited.

A.198 The implications for direct labour costs of the introduction of shiftwork are complex. A premium of one-third of the day rates appears to be sufficient inducement for recruitment of workers for a night shift in any area, provided these day rates correspond to the prevailing market rates in that district for the trades concerned. If there is dissatisfaction among dayworkers regarding their own earnings, particularly if overtime is restricted, the introduction of a night shift may aggravate this.

A.199 Some *ancillary services* must be provided even for a small night shift; these include refreshment, medical and emergency technical services. It is, however, possible to combine those and other functions to some extent and the ratio of indirect to direct labour need not be much higher during the night than during the day.

A.200 Among *other costs* of nightwork, the most obvious is lighting. For local work only local illumination is needed. For welding, the reduction of the period during which pre-heat need be maintained will save much more electricity than that consumed by lighting at night. General floodlighting of open sites would require more expensive lighting installations but such floodlighting should only exceptionally be required. Work in darkness also requires the use of modified scaffolding to reduce accident risks but the cost of this is comparatively small.

A.201 *Two or three shifts?* The report supports two rather than three shifts partly because overtime for dayworkers may be a necessary corollary of the introduction of multiple shifts. In addition a two shift system provides a period in which radiographic and ultrasonic testing and maintenance may be effected.

The effective application of shiftwork

A.202 With certain unusual exceptions (eg where expensive hired plant is used) nightwork should be undertaken only when this would advance the completion of the project, that is it should be confined to critical activities.

A.203 Using network analysis, the writers examined the scope for shiftwork in the erection of two splitter columns at Grangemouth. This example showed:

(a) that it may be uneconomical to undertake more than a very limited volume of nightwork when some activities are suitable and others not;

(b) that this limited nightwork may yield a disproportionate reduction of the total construction period. In this case, a saving of 13 per cent of the construction period could, in principle, be achieved with an increase in total costs of about 1·5 per cent.

Conclusions

A.204 At the majority of power stations and oil refinery projects, the cost of materials purchased from off-site suppliers accounts for between 75 and 85 per cent of total costs. Labour costs account for about three-quarters of the remainder. The employment of a small night shift on selected critical activities is therefore unlikely to increase total costs appreciably. The effectiveness of such limited shiftwork in reducing the construction period has been shown and the consequent savings in capital costs are likely to be substantial.

A.205 The report recommends that the economics of nightwork be carefully investigated at the planning stage of all large projects. The use of network analysis is recommended and the writers urge that the most effective use of shiftwork should be one of the objectives which project planners should seek to fulfil.

Copies of the complete report may be obtained from the National Economic Development Office, 21/41, Millbank, London, S.W.1.

Appendix 7 Work standards in plant construction

(See section headed 'Incentive payment schemes' under Chapter 4 on page 44)

A.206 Group 2 of our Working Party concentrated on problems of industrial relations.

A.207 When examining incentive payment schemes we were anxious to see whether it was possible to establish common 'work norms' to be used throughout the industry, not only for incentive payment schemes, but for the purposes of estimating, planning, and the control of work. Such a 'Data Bank' of standards coupled with a common form of 'gearing' ie the way the rate of bonus payment increases as performance increases would provide the basis for a uniform incentive payment scheme throughout the industry.

A.208 We therefore commissioned Mr J Claxton-Smith B ENG, FIWSP to examine a variety of mechanical construction work on five power stations, two refineries and one chemical complex, to ascertain if such a 'data bank' was both a theoretical and practical possibility.

A.209 A synopsis of the findings of Mr Claxton-Smith follows. A copy of his full report to the Working Party may be had on application to the National Economic Development Office, 21/41 Millbank, London SW1.

Conclusions

A.210 There are common types of mechanical erection work on all types of sites. There is also a common sequence of work and a frequency can be defined for these different types of work.

A.211 There is a need for common performance standards for estimating planning and controlling work and for incentive payment schemes.

A.212 Certain common performance standards have already been applied on some sites to obtain greater uniformity of earnings, but they are unsuitable for expansion in their present form.

A.213 The industry should seek to set up a 'data bank' containing descriptions and basic times established by agreed work study techniques of those small elements of work which are most frequently found in mechanical erection work. A start should be made with several interested contractors and possibly clients, setting standards for pipework and plating. It is emphasised however, that what is proposed is not merely the introduction of a data bank, but the expansion of work study expertise throughout the industry. The prerequisites for success are co-operation among contractors, and adequate trained work study staff.

The work

Sequence

A.214 The mechanical erection work on all the sites visited followed a fourfold *sequence* ie;

(a) *moving* the parts (either from store or direct from the manufacturer's transport)

(b) *erecting* the part into its approximate final position

(c) the part is next *set* into its exact position

(d) finally the part is *fixed* (usually by welding or bolting to the structure).

A.215 Because of the size of so many of the parts, and the limited and differing scope for manoeuvre, sequences (b) and (c) (erection and setting) can present special problems in using standards.

Type A.216 The mechanical erection work is mainly of the following types:

(a) pipework (on oil refinery and chemical plant construction it was stated that 30 per cent of the erection man hours were used in pipework)

(b) plating

(c) installation of pumps, motors, cabling, switchgear

(d) structural steelwork.

Category and frequency A.217 The work can be explained in work measurement terms as following three categories which follow one from the other. The first and basic category consists of those simple elements such as using tools, lifting manually a part or piece of equipment, and fastening parts. The second category derives from different combinations of these first basic elements, such as running lengths of pipework and installing pumps. The third is a more complex category, and consists of a combination of the first two, such as installation of a furnace wall. Obviously the first category of work occurs most frequently and occurs in the activity of all contractors. The second and third categories of work are more specialised and occur less frequently.

A.218 A small amount of work, such as lining up the turbine and alternator shafts, is very highly specialised and requires a high degree of skill. It is not easy to predict the content of this work.

Workshop activity A.219 The amount of 'workshop' activity on these sites is significant (up to 20 per cent of the erection man hours is employed in this way). It consists of the manufacture of certain parts that present special transport difficulties, and the modifications of parts sent by manufacturers because of work errors and late design changes. This work can be quite considerable and complex.

Work standards A.220 It is important for any discussion of a data bank of performance standards to stress that standards of performance of some sort do exist. Contractors have to have some standards in mind for estimating and planning work. *It is not therefore a question of introducing standards but of considering whether they can be formulated in a better way.*

A.221 The present standards derive almost invariably from the contractors' past experience of similar work. Their characteristics are:

(a) they are very rarely based on any work measurement in a work study sense;

(b) they are generally expressed in large segments of work involving many men and hundreds of man hours;

(c) they are not negotiated with the workforce when first implemented in an incentive payment scheme, but almost invariably become the subject of crude bargaining conducted without reference to any acceptable criteria.

Incentive payment schemes A.222 The types of scheme encountered were:

(a) lump sum

(b) individual schemes

(c) team schemes

(d) productive labour

(e) whole site.

A.223 Bonus payments usually ranged from 30 per cent to 100 per cent of the same basic pay. Judging from the constant complaints by management of poor output, it is questionable if the high bonus payments are related to output in a realistic way.

A.224 Financial incentive payment schemes seeking to increase the effort of workers by suitable rewards have their attractions to contractors. Certainly many contractors are convinced of their value, and would be extremely reluctant to abandon them.

A.225 The factors which caused the changes in earning were due to:

(a) the effort of the operatives,

(b) availability of work and materials,

(c) correct or incorrect materials,

(d) ease or difficulty of access,

(e) the psychological effect of the 'norm' that had been fixed,

(f) inclement weather.

A.226 It will be seen that all but the first of these factors are outside the direct control of the operator. Moreover, though it was possible to ascertain from the records that bonus earnings fluctuated from week to week, this fluctuation was mitigated in some cases by the practices of 'banking' and manipulation of bonus earnings by either managers or workers, or both in collusion.

A.227 Managers are faced with the problems associated with all incentive payment schemes. They depend for their success on a smooth flow of work, correct materials, ease of access, correct manning and co-ordination between gangs. But the difficulties of achieving these conditions are formidable.

A.228 A scheme must also be conveyed to, understood and accepted by the labour force. Yet few schemes are explicitly formulated or properly explained to the workforce, and there is no accepted criteria of what is reasonable.

The case for a data bank

A.229 The introduction of common 'norms' on some sites by some influential clients has already been described. They are an attempt to avoid the gross anomalies and discrepancies of uniformity of earnings by the use of common performance standards. *The need and the solution are thus demonstrated.* It is suggested, however, that the scope for their extension to the industry as a whole, instead of to individual sites should be examined.

A.230 There is also a need for standards which can be used not only for pay purposes but also for planning and control. This is of pressing importance to a client or his main contractor because such standards can facilitate overall control.

A.231 As has been described, it was found that the work on all the sites visited followed a common sequence of move, erect, set and fix, and that there are common types of work. Within these types there are common categories, eg using tools, and a frequency which can be defined. These concepts provide a framework for the examination of erection work. Within this structure certain distinct categories of work can be identified, and then broken down into their constituent parts. As this analysis proceeds certain elements which occur in more than one job appear. Thus the basic elements of work which occur on site are exposed. It is these elements of 'bricks' which can be assembled in different combinations to form larger tasks which should be collected into a data bank. These bricks lend themselves to measurement and definition by conventional work study techniques, and work study practitioners are already experienced in the techniques of building them into larger segments of work, as well as valuing them to a common defined level of performance. Such standards can be used on all sites. They provide information for planning and control. They can be communicated to the workforce and they can be negotiated.

A.232 It will be seen that this is a reversal of the process now being used, whereby standards are set for large segments of work based on past experience. It is suggested that in future the standard for these large segments be built up from measurements of the bricks described.

A.233 It is accepted that site erection work presents special problems. It was found that certain of the work on sites is not repetitive, and that the content of some highly skilled work cannot be predicted with precision. There are also problems such as access difficulties, work errors, forced changes in the sequence of work, and inclement weather, all of which require that the data be interpreted and used with skill and judgment. These difficulties do not constitute an argument for not having these standards. It is repeated that some standards are essential. There are, however, reasons for not applying them slavishly, or applying incentive payment schemes where they are not appropriate. The arguments therefore for the establishment of a data bank for the industry are:

(a) contractors need and must eventually acquire such standards for more efficient estimating, planning and control of work;

(b) they are also required for more effective and equitable incentive payment schemes;

(c) such standards can be obtained much more cheaply by co-operation;

(d) by making a start now a great deal of time and resources will be saved.

The introduction and economics of a data bank

A.234 A data bank presupposes that contractors will be prepared to place certain data obtained by agreed work measurement techniques into a common pool. Obtaining a common understanding of the defined 'level of performance' against which all work standards will be produced does not present an insuperable difficulty.

A.235 It is to be expected that the definition of techniques to be used and the collection of data would cover a period of about two to three years. The assembly of data would be slow at first, but grow more rapid. Even so there would be a time lag of about 18 months before worthwhile data could be released.

A.236 Would such a data bank provide a pay-off? It is obvious that b co-operating in this way, companies could make considerable savings in scar work study resources. Will such a change make for greater efficiency and profitability of individual contracting firms? Only experience can prove this. But it is possible to take a view. To use the data and contribute to it on a project involving labour erection costs of £1,000,000 (about 250 men over two years) would require up to a maximum of eight work study practitioners (depending on the nature of the work) at an annual cost of about £20,000. The assumption must also be made that the senior project management are trained to make effective use of such expertise. Would savings of more than 2 per cent be achieved in labour productivity? It is reported that the present general rate of effective activity on sites is less than 40 per cent and that there is enormous scope for improvement in the planning, control and payment of labour. There seems no doubt that an investment even on this modest scale could make an improvement in labour utilisation.

Appendix 8 The welfare code

Introduction

A.237 In the body of the report, the Working Party recommends that there should be a high and consistent standard of amenities on all sites of the kind with which the report is concerned. It was felt that in the absence of any commonly recognised standards the preparation of a code would help to achieve this objective. Accordingly the Working Party, with expert advice, has drawn up a 'welfare code', which covers medical and first aid facilities, shelters and accommodation for clothing, washrooms and lavatories, catering, transport, car parks and living accommodation. The code in no way attempts to derogate from the existing statutory requirements which regulate conditions in some of these areas,* but rather supplements them in a way appropriate to construction projects which are often very large and cover a long time span.

A.238 The Working Party's aim will be achieved primarily if all clients decide to adopt the code, and hence assume responsibility for ensuring that adequate standards of amenities are provided on their sites. In practice this will mean either providing all the code's facilities themselves, or engaging one or more 'common services' contractors to do so—in which case the code could form the substansive part of the contracts. By either means, a higher standard of central services, eg canteens, will be achieved than could be expected of individual employing contractors working separately. It may be considered preferable to allow individual contractors to supply some 'decentralised' services, eg shelters; in this case clients would ensure that the code's provisions were complied with by specifying them in their contract documents.

A.239 Contractors and unions, for their part, are recommended to express in any national or site agreement they conclude, their desire that the standards of this code will be met on site.

Medical and first aid facilities

First aid boxes or cases

A.240 A sufficient number of suitable first aid boxes or cases shall be provided and kept clean, in good repair and reasonably accessible from all positions where work is proceeding on the site. The content of such boxes shall comply with the requirements of Statutory Instrument No 95,† and the provision of this regulation regarding the number of boxes, their marking, responsibility for providing, and qualifications in first aid treatment of responsible persons in charge of the boxes, shall be strictly observed.

First aid room—medical centres

A.241 On all sites where more than 250 men are employed at one time, a properly constructed and suitable first aid room with heating facilities, to be used solely for purposes of treatment and rest to the standards specified in Statutory Instrument No 95 shall be provided; also, the services of a person trained in first aid treatment to the standards laid down in this Regulation, who shall always be readily available during working hours.

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*Provision of common site facilities does not, of course, cut across the statutory obligations of contractors to their own employees, since the regulations permit a contractor to make arrangements with another contractor or person in discharge of his obligations (The Construction (Health and Welfare) Regulations, 1966, Section 4).

†Statutory Instrument No. 95 is the Construction (Health and Welfare) Regulation, 1966.

A.242 On sites where 500 or more men are employed at any one time the first aid room described in the previous paragraph shall be equipped and utilised as a medical centre with a full time trained nurse in charge, and arrangements shall be made to have a doctor on call. Where the extent of the site area requires it, there should be provided, in addition, a sufficient number of ancillary first aid posts located at strategic points on the site, each of which shall be the responsibility of the person who is in charge of the first aid boxes: such ancillary first aid posts shall be so constructed as to be used only for this purpose and to provide adequate shelter and rest facilities pending removal of casualties to the main medical centre.

Ambulances

A.243 The requirements of Statutory Instrument No 95 in regard to notification of the local health authority and the summoning of ambulances shall be complied with. Where these requirements would not give ready access to an ambulance, an ambulance and a driver shall be provided for the purposes of conveying casualties to the site medical centre or to the nearest hospital designated by the local health authority. Such a vehicle shall be provided in every case where the number of men on site exceeds 500.

Shelters and accommodation for clothing

A.244 In accordance with the requirements of Statutory Instrument No 95 (Regulation 11), accommodation for taking meals, for the storage of clothing, and for changing shall be provided. Thus, such buildings shall be adequately heated and have facilities for boiling water and for heating food, and there must be either within the shelter or in close proximity thereto a source of drinking water clearly marked as such. Storage of clothes should be by means of separate, securable lockers, or by means of fixed bars from which are suspended cloakroom hangers, each hanger having a lockable basket capable of holding a safety helmet amongst other personal belongings. Provision should also be made for the storage of rubber boots.

A.245 For the purpose of drying clothes, drying rooms with appropriate heating appliances, adequately ventilated, and sited either separately or attached to the accommodation described in § A.244 shall be provided.

A.246 On a large or dispersed site, shelters and drying rooms should be conveniently situated as close as possible to the various sectors of work, and be sufficient to cater for the needs of the entire force employed on the site.

A.247 It is recognised that such accommodation will normally be provided by each contractor for the men he employs. However, the client or his agent (eg a main contractor) will ensure that all workmen, including the employees of contractors employing a very small or transient workforce, shall have accommodation to the standards described in § A.244 and A.245. For this purpose it may be necessary to make available common or shared facilities (on a mutually acceptable financial basis).

A.248 All accommodation described in this section shall be maintained in good order and in a state of cleanliness.

Washrooms and lavatories

A.249 Compliance with the requirements of Statutory Instrument No 95 shall be interpreted in the manner described as follows.

A.250 The scale of provision for wash basins shall be (as a minimum) in accordance with that laid down in the Regulation, viz: four for 100 persons, with the addition of one for every 35 persons in excess of 100 (any fraction of the unit of 35 persons being treated as one). The minimum requirements laid down in the Regulations shall be interpreted in a generous manner and a high standard of facilities proved in respect of soap, towels, hot and cold water and nail brushes. In addition, at least one shower cubicle shall be provided to each washroom.

A.251 The scale of provision for sanitary conveniences shall be (as a minimum) in accordance with that laid down in the Regulation, viz: one (flushing) WC for every 25 persons up to the first 100 and one for every 35 persons thereafter plus adequate urinal provision.

A.252 Washrooms and lavatories should normally be combined, and they must be sited in convenient proximity both to centres of work and to the shelters (§A.244), care being taken to ensure that the allocation of units is in accord with the numbers of workmen employed at each centre of work. Where large or high buildings are under construction it is necessary to provide urinals or closets inside the precincts and at various levels. Suitable mobile facilities would satisfy this requirement.

A.253 Full time attendant(s) must be provided to patrol and look after the cleaning of washrooms and lavatories.

A.254 The provisions of the Regulation with respect to ventilation, lighting, screening, etc must be strictly observed.

A.255 The drainage should if possible be integrated with the permanent sewerage system of the project but in cases where this is impracticable it will be permissible to arrange a cesspool system periodically emptied by suction tankers.

Protective clothing and safe access to facilities

A.256 Statutory Instrument No 95 stipulates that adequate and suitable protective clothing for employees shall be provided. This requirement will devolve on each contractor or subcontractor working on the site.

A.257 The requirement in regard to safe access to and egress from all the facilities previously mentioned as laid down in Statutory Instrument No 95 must be observed and this should be reinforced by the appointment of safety supervisors and a full time safety officer whose responsibility will extend to the constructional work as a whole. The contractual responsibility for all such safety supervision on the site is therefore specifically included within this code but the requirements of Statutory Instrument No 94, the Construction (Working Places) Regulations, 1966—the regulations dealing with scaffolding, etc—will be covered within the terms of each contract operating on the site and are therefore excluded from the scope of this code.

Catering—canteens

A.258 In determining the question of whether or not canteen facilities are required on any site regard shall be had to the number of persons who appear likely to use the canteen. Under normal circumstances, it would be necessary to provide a canteen where the total number of men will exceed 50. Where a canteen is required, the aim shall be to provide a common centre sufficient to meet the needs of the whole site (and also the needs of the residents of the site camp where the camp is in close proximity to the site).

A.259 Where there are existing permanent facilities (eg a client's own canteens) on or very close to the site the requirements stated above may be modified according to the degree of availability of the existing facilities.

A.260 In addition to the provision of mid-day meals or meals at times appropriate for shiftworkers or weekend workers, the canteen service must be capable of providing tea during breaks and, where necessary, of maintaining a distribution service at these times to the shelters referred to in § A.244.

A.261 Canteen buildings shall be soundly constructed and with a good standard of furnishing. They shall be so designed and built as to be of semi-permanent type rather than to have a purely temporary life. Adequate lighting and ventilation shall be provided. Floors should be of concrete or other stable construction and have a durable finish capable of frequent washing. A washable finish to dado height should be provided for the internal linings to walls. Internal decoration should be in light shades and carried out on erection and subsequently renewed as necessary.

A.262 Canteen tables should be of laminated plastic topped or of other impervious material, and sturdy seating should be provided.

A.263 Cooking and washing-up facilities may be incorporated within the canteen building itself or in a suitable annex, and water supply and drainage provision must be made. General room heating to the canteens must be sufficient to maintain a minimum internal temperature of 65°F (18°C).

A.264 The buildings and all furniture, etc are to be maintained in a good state of repair and cleanliness throughout their life.

A.265 Since during meal breaks there will be a large concentration of people under one roof due regard should be paid to the means of escape in case of fire, fire alarms, fire drills and the provision of suitable fire-fighting equipment.

On-site facilities—general

A.266 The standard of construction for washrooms and shelters shall be of a substantial nature, and in the case of washrooms the finish shall be such as to make possible the frequent hosing down of the structure internally. Each washroom and lavatory shall be inspected and thoroughly cleaned every morning and afternoon. Shelters shall be brushed out and cleaned daily after working hours so that dust is not raised when non-working clothing is being stored. The floor shall be washed at least once per week.

A.267 In the canteens, following each meal break, all tables and counters are to be wiped down, the floor brushed and cleaned, and refuse containers emptied and cleaned. All wall dados and the floor are to be washed twice per week.

A.268 Suitable receptacles for depositing waste, etc must be provided at convenient points inside and outside canteens and shelters: they should either be disposable or of robust quality and capable of frequent scouring.

A.269 Adequate facilities should be provided for the cleaning of rubber boots: these should be located near the canteen and/or shelter entrances but sufficiently distant so as to avoid the creation of untidiness at the entrance, and a hard access path should be provided from the washing place to the entrance. The facilities should include water, brushes, scrapers, etc—this requirement would best be met by a mechanically revolving brush and spray.

A.270 No storage of plant, tools, materials, etc is permissible in any of the welfare buildings, nor should any stores, etc provided for this purpose be used in any way as a shelter.

A.271 Shelters and canteens must be lockable and secure from intrusion when not in use.

A.272 Where there are site fabrication shops or stores with men consequently working therein there is a statuory obligation to provide heating and ventilating. Such provisions, being part of the cost of setting up work shops etc, fall within the responsibilities of the relevant contractors and do not properly come within the ambit of site amenities: they are therefore excluded from this code.

Transport

A.273 Transport facilities to convey workmen daily between suitable centres in the surrounding district and the site must be provided as necessary. The extent to which this service is required will depend upon the location of the site in relation to sources of labour supply.

A.274 In addition, on large sites it may be necessary to provide some transport on the site itself at the mid-day break to convey men to and from the canteen.

A.275 The buses should be heated, clean and comfortable and the services should not only be punctual but should be carefully planned to work in with public transport systems.

Parking of workmen's cars

A.276 Suitable car parking facilities shall be provided for workmen who use their own cars to reach the site. The location may be on site if space is available.

Otherwise land in close proximity should be allocated—this will require to be fenced and patrolled in the interests of security. The surface of car parks should be adequate for cars to stand on without undue rutting or mud formation in bad weather.

Living accommodation

A.277 On certain sites it may be necessary to set up site camps. The client's decision to do so will be influenced by the availability or non-availability of labour sources and the distances involved in transport. Since the extent of such sources may not initially be determinable, extensions to the camp may be called for during the site construction period.

A.278 In the event of a camp being necessary the following provisions shall apply.

Scope

A.279 Living and sleeping accommodation is to be by a single room for each man: normally these will be in buildings containing around 24 individual rooms.

A.280 A clothes drying room to each building with hangers and heaters shall be provided; also laundry facilities for personal needs and for bed linen, towels, etc; which should be changed weekly.

A.281 An adequate canteen capable of supplying evening meals, breakfasts, snacks and meals at weekends shall be provided.

A.282 Washroom and lavatory accommodation shall be so sited as to be readily accessible to each unit of sleeping accommodation. Hot and cold water shall be available at all times (except that during working hours the hot water supply may be curtailed). Provision should be not less than one WC, one urinal stall, two wash basins and two baths or showers for each 12 persons accommodated in the camp.

A.283 A recreation block for the whole camp will be provided, and also small recreation rooms for each building. The recreation block will provide separate accommodation for two television sets, and also for other facilities, eg billiards, darts, table tennis which may be stipulated at the outset, or requested later (with client's consent) by the camp committee (see § A.293). The small recreation rooms will have easy chairs and facilities for reading, writing, and for cards or similar games to be played.

A.284 Attendants will be provided for cleaning, bed-making and changing of bed linen.

A.285 Consideration should be paid to establishing a sick bay and a first aid room within the camp.

A.286 Clients consideration will be given to the provision of a sports ground, a camp cinema, a post office, public telephone boxes and a general store.

Construction etc

A.287 The buildings should be soundly constructed with adequate lighting and heating facilities to all units. The heating arrangements are to be such that a minimum internal temperature of 65°F (18°C) can be maintained in recreation rooms and up to 60°F (16°C) obtainable in sleeping accommodation.

A.288 A fire warning system, fire extinguishers and clearly marked fire escapes shall be provided, and fire drills established.

A.289 Furnishings to sleeping accommodation should be of good average quality and include window curtaining, a bed, easy chair, wardrobe, mirror and chest of drawers. Carpets will be provided to all bedrooms and recreation rooms. A good standard of decoration is to be maintained in all buildings.

A.290 Rooms shall be lockable.

Wet canteen

A.291 Where a camp is situated more than two miles away from the nearest licensed premises space is to be provided in the camp for a wet canteen.

Religious facilities

A.292 Arrangements should be made where required for visits from clergymen to officiate at religious services and for the use of a recreation room and its temporary conversion for the purpose. Alternatively, or in addition, transport may have to be provided for men to attend religious services outside the camp.

Camp committee

A.293 It is expected that a committee of the camp's residents will be elected to make suggestions about the running of the camp and to channel complaints. A representative of the organisation managing the camp will make himself available to discuss relevant matters as they arise with the committee chairman, and to attend periodic meetings of the camp committee and the client's management. In addition the committee would be responsible for organising the recreational activities mentioned in § A.283, and also outdoor activities, eg football, angling, etc, for which there was a demand.

Caravan site

A.294 On certain sites a caravan park will be required to accommodate those workmen who wish to live in their own caravans (with their families). Where approval to this arrangement is given by the client and the local authority the facilities described below shall be provided.

A.295 A suitable location quite separate from the site camp is to be selected and the surface of the ground levelled and prepared for the parking of caravans: it will usually be necessary to prepare the surface by a layer of road metal or hard core and a system of concrete paths must be provided for access to each caravan standing.

A.296 A supply of certified mains (drinking) water is to be laid on to the site with a stand-pipe and tap at each standing; at each stand-pipe location there is to be provided a gully trap to receive waste water connected by a proper drainage system to the appropriate out-fall for waste water disposal.

A.297 Each standing will have a supply of electricity and a suitable outpu socket, weather-proofed and safe-guarded, is to be installed to take the lead-in cable from each caravan.

A.298 A small hut for storage purposes, properly floored, is to be provided to each standing.

A.299 Two ablution blocks (one for each sex) of a size suitable to accommodate the total number of persons occupying the caravan site will be provided. The facilities will include wash basins, showers, baths, water closets (with urinal stalls in the male block) and full provision of hot and cold water supplies and a foul drainage system. Where possible, the hot water and drainage system may be linked up with those of the main camp site to avoid duplication of provision. It is not intended that towels, soap and attendants for cleaning should be provided in these caravan site ablution blocks, these being the responsibility of the occupants themselves. The standard of construction and maintenance of these buildings shall be similar to that specified for other washrooms on site.

A.300 A washing and drying room equipped with sinks, drying racks or hanging rails, hot and cold water supplies and drainage is to be provided, or (where economical) coin operated washing machines.

Site employment office and welfare officer

A.301 It may be found convenient for an office and staff to be provided to centralise and facilitate the processes of men seeking employment (and local lodgings) or changing employers on the site and to deal with all questions of welfare including the supervision of the whole of the facilities named in this code.

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National Economic Development Office

Large Industrial Sites

Report of the working party on
large industrial construction sites

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Contents

Foreword v
List of members vii
Acknowledgements ix
List of abbreviations x
Summary 1
Introduction 7
Chapter 1 Management by client and contractor 15
  Introduction 15
  Form of contract 16
  The number of direct contractors 19
  Responsibility for research and design 21
  Design delays and variations 23
  Penalties and incentives 24
  Site services 25
  Clients' project teams 26
Chapter 2 Training 29
  Management training 29
  Craft training 30
Chapter 3 Programming 34
Chapter 4 Industrial relations problems 39
  Pay and conditions: the present position 39
  National and site agreements 42
  Incentive payment schemes 44
  Proposed comprehensive national agreement 45
  A national joint council 48
  The client's role 49
  Four matters for negotiators 50
  Amenities 53
  The problem of casual labour 54
  Conclusion 58
Chapter 5 Proposals for follow-up 60
Appendix 1 Industrial construction: forecasts of expenditure and manpower requirements 61
  Estimates of fixed capital expenditure 61
    Electricity generating 61
    Petroleum refining 62
    Chemicals and allied industries 62
    Non-ferrous metals 62
    Iron and steel 63
    All industries: total expenditure 64
  Manpower requirements—the manpower trend 64
    Annex 1: Electricity generating: likely power station programme 1970–1979 (CEGB and SSEB) 67
    Annex 2: Statistical method of arriving at labour requirements from a total installed cost (refinery and petrochemical plants) 69
Appendix 2 The survey among contractors 71
  Summary and conclusions 71
  The contractors and their labour force 73
  Managerial policy on employment 76
  Labour turnover and stability 78
  The recruitment of operatives and skill shortages 82
  The employment of specialist staff 84
  The causes of delay 86
  Earnings and hours of work 87
  Annex: NEDO list of large industrial construction sites 96

Appendix 3 Reports by the Department of Employment and Productivity 97
1 Findings of regional manpower advisers 97
  Introduction 97
  Multiplicity of contractors 98
  The need for greater management expertise in handling industrial relations 98
  Pre-planning and co-ordination of industrial relations 99
  Disputes procedures 100
  Discipline 101
  Shop stewards 101
  Recruitment and selection 102
  Continuity of employment 102
  Pay 102
  Site amenities 103
  Annex I: An example of a particularly troubled site 103
2 Statistics of stoppages of work due to industrial disputes 104

Appendix 4 Comparison of agreements operating on large industrial sites 108
Holidays 108
Special allowance for conditions 110
Merit responsibility payments 111
Meals and tea breaks 112
Welfare facilities on site 112
Termination of employment 112
Overtime 113
Hours of work 114
Protective clothing 115
Tools 116
Shiftwork 116
Trade union facilities 117
Disputes procedures 118
Demarcation 119
Incentive schemes 119
Wages rates 120
Daily and periodic travelling and lodging allowances 120

Appendix 5 Large industrial projects—construction plans and achievements 125

Appendix 6 Shiftworking: the feasibility and economics of multiple shifts on mechanical work at large industrial construction sites 127
Introduction 127
The potential benefits of shiftwork 127
Practical considerations 128
The effective application of shiftwork 129
Conclusions 129

Appendix 7 Work standards in plant construction 130
Conclusions 130
The work 130
Work standards 131
Incentive payment schemes 131
The case for a data bank 132
The introduction and economics of a data bank 133

Appendix 8 The welfare code 134
Introduction 134
Medical and first aid facilities 134
Shelters and accommodation for clothing 135
Washrooms and lavatories 135
Protective clothing and safe access to facilities 136
Catering—canteens 136
On-site facilities—general 137
Transport 137
Parking of workmen's cars 137
Living accommodation 138
Caravan site 139
Site employment office and welfare officer 139

Foreword by the Chairman

This report on mechanical and electrical construction is prepared by members of the industry for the industry. It does not look to the Government for help, other than to emphasise that the more stable an economic environment the Government's economic managers can produce the less difficult will be the job of introducing reform into this key sector.

We have reported at length and have included detailed appendices. We have done so because the story is complex and because the facts have not been put together before. We seek changes in practice from all concerned—client, contractor, union, institution. We are hopeful that such changes will emerge. We have carefully analysed the facts, and the ways forward we recommend are practical, drawn up by practical, knowledgeable men from the industry. Our discussions on the working party and with people at all levels in the industry have left us in no doubt that the urge for reform is strong. We hope that this report will provide the occasion for it.

On behalf of the members of the Large Industrial Construction Sites Working Party, Lord Wright and I would like to mention how impressed we have been with the work of the National Economic Development Office in the preparation of this report. The team has been headed by Michael Beales, assisted by Tom Shaefer, Alan Reddrop and Keith Baker and supporting staff. Their tact, diplomacy and skill in personal interviews, in preparing the papers for the meetings, in summarising our discussions, in marshalling the statistics and in drafting the report have been outstanding. We are most grateful to them all.

T A L Paton

Membership of the Large Industrial Construction Sites Working Party

	Chairman
Mr T A L Paton CMG, FRS	Senior Partner, Sir Alexander Gibb & Partners
	Deputy Chairman
Lord Wright of Ashton under Lyne CBE	Formerly President, Trades Union Congress
	Members
Mr N Aldcroft	Managing Director, F A Norris & Co Ltd
Mr J Anderson	Director, Geo Wimpey Ltd
Mr R M Arnold	General Manager, Outside Department, C A Parsons & Co Ltd
*Mr J M Beales	Assistant Industrial Director, National Economic Development Office
Mr M Bett	Formerly Assistant Director, now Director, Engineering Employers' Federation
Mr E S Booth FRS	Member for Engineering, Central Electricity Generating Board
Mr T Carlile	Managing Director, Babcock & Wilcox Ltd
(**Deputy*: Mr S R Wood	General Manager, Construction Division, Babcock & Wilcox Ltd)
*Mr E D Causey	Chief Construction Manager, The Lummus Co Ltd
Mr J Chalmers	General Secretary, Amalgamated Society of Boilermakers Shipwrights Blacksmiths and Structural Engineers
Mr G H Clarke	Regional Manager, G N Haden & Sons Ltd
*Mr T N C Garfit	Secretary, Oil & Chemical Plant Constructors' Association
Mr L Green	Assistant General Secretary, National Union of Sheet Metal Workers Coppersmiths & Heating & Domestic Engineers
Mr E A B Hammond	Executive Councillor, Electrical Electronic Telecommunications Union/Plumbing Trades Union
Mr W J Harper	Director, Constructional Engineering Division, British Steel Corporation
Mr I A Hutchison	Manager, Construction Division, BP (Trading) Ltd
Mr L Kemp	National Secretary, Building & Construction Engineers Group, Transport & General Workers' Union
Mr R W Lerrigo	Director, Shell UK Ltd
(*Deputy*: Mr P S Meredith	Chief Engineer, Shell UK Ltd)
Mr P S Linklater	Director (Personnel), Shell UK Ltd
Mr C Lovell	National Secretary, Plumbing Section, Electrical Electronic Telecommunications Union/Plumbing Trades Union
Mr E Marsden	General Secretary, Constructional Engineering Union
Mr W H Marsh OBE	Department of Employment and Productivity
Mr J G Minns	Site Section Executive Officer, Engineering Employers' Federation
Mr H W Moys	Personnel Director, The Gas Council
Mr E Patterson	Formerly General Secretary, Constructional Engineering Union
Mr M N Pickett	Manager, Engineering Contracts & Purchasing, Esso Petroleum Co Ltd
Mr D W Portus	Director & General Manager, Engineering Services (Wilton) Ltd
*Mr W H C Pilling	Director, Southern Project Group, Central Electricity Generating Board
Mr C E Ringwood	Ministry of Public Building and Works
Mr G T Shepherd	Formerly Director of Engineering, South of Scotland Electricity Board, now Deputy Chairman, London Electricity Board
Mr V J Stock CBE	Managing Director, Berkeley Electrical Engineering Co Ltd
Mr H J O Weaver	General Secretary, National Federation of Building Trades Operatives
Mr R W Wright	Executive Council Member, Amalgamated Union of Engineering and Foundry Workers
	Secretariat
*Mr A D Reddrop	National Economic Development Office
*Mr K H Baker	National Economic Development Office
	Consultant
Mr I T Shaefer	National Economic Development Office

The following, in addition to certain members of the main working party (indicated thus *) comprised Group 3, which was set up to prepare the statistical information on construction activity.

Mr N S Bailey	Managing Director, N G Bailey & Co Ltd
Mr D Delay	Assistant Secretary, Economic Department, Trades Union Congress
Mr L Gray	Chief Buyer, Geo Wimpey MEC Ltd
Mr W K Hall	Formerly Development Director, Chemical Industries' Association
Mr R A Husain	National Economic Development Office
Mr A B Ketterer	Industrial Relations Officer, Engineering Employers' Federation
Mr F G Mooney	Ministry of Public Building & Works
Mr D B Price	Department of Employment & Productivity
Mr D J Stannard	Department of Employment & Productivity
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Heating & Domestic Engineers' Union
Heating & Ventilating Contractors' Association
W C Holmes & Co Ltd
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Wheeler Crittall Berry Ltd
Whessoe Ltd
G Wimpey ME-C Ltd
Woodall-Duckham Ltd
Yarrow & Co Ltd

List of abbreviations

AEF	Amalgamated Union of Engineering and Foundry Workers
API/ASME	American Petroleum Institution/American Society of Mechanical Engineers
BSC	British Steel Corporation
CEGB	Central Electricity Generating Board
CEU	Constructional Engineering Union
CIA	Chemical Industries' Association
CITB	Construction Industry Training Board
DEP	Department of Employment and Productivity
EDC	Economic Development Committee
EETU/PTU	Electrical Electronic Telecommunications Union/Plumbing Trade Union
EITB	Engineering Industry Training Board
GTC	Government Training Centre
JIB	Joint Industry Board (for the Electrical Contracting Industry)
MIN TECH	Ministry of Technology
MPBW	Ministry of Public Building and Works
MW	Megawatts
NEDO	National Economic Development Office
NFEA	National Federated Electrical Association
NJIC	National Joint Industrial Council
OCPCA	Oil and Chemical Plant Constructors' Association
SSEB	South of Scotland Electricity Board
TIC	Total Installed Cost
UKAEA	United Kingdom Atomic Energy Authority